RECOGNITION AND IDENTIFICATION OF EXTERNAL BRANCH OF SUPERIOR LARYNGEAL NERVE AND ITS IMPLICATION IN THYROID SURGERY.

Dissertation submitted to

THE TAMILNADU

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CHENNAI – 600032

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For the Award of the Degree of

M.S. GENERAL SURGERY (BRANCH - I)

APRIL – 2015

DEPARTMENT OF GENERAL SURGERY

MADURAI MEDICAL COLLEGE AND GOVERNMENT RAJAJI HOSPITAL

MADURAI – 625020

CERTIFICATE

This is to certify that this Dissertation titled" **Recognition and identification of external branch of superior laryngeal nerve and its implication in thyroid surgery"** at Government Rajaji Hospital, Madurai submitted by **DR.V.MURALIDHARAN**, to the faculty of General Surgery, **The Tamilnadu Dr. M.G.R. Medical University, Chennai** in partial fulfillment of the requirement for the award of MS degree (Branch I) General Surgery, is a bonafide research work carried out by him under my direct supervision and guidance from November 2013 to September 2014.

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This is to certify that this Dissertation titled **" Recognition and identification of external branch of superior laryngeal nerve and its implication in thyroid surgery" at Government Rajaji Hospital, Madurai** submitted by **DR. V.MURALIDHARAN**, to the faculty of General Surgery, **The Tamilnadu Dr. M.G.R. Medical University, Chennai** in partial fulfillment of the requirement for the award of MS degree (Branch I) General Surgery, is a bonafide research work carried out by him under my direct supervision and guidance from September 2013 to September 2014.

I have great pleasure in forwarding it to The Tamilnadu Dr. M.G.R. Medical University, Chennai.

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Date:

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **" Recognition and identification of external branch of superior laryngeal nerve and its implication in thyroid surgery ”** is a bonafide and genuine research work carried out by me in the Department of General Surgery, Madurai Medical College, during the period of November 2013 to September 2014 .This is submitted to **The Tamilnadu Dr. M.G.R. Medical University, Chennai**, in partial fulfillment of the regulations for the award of MS degree (Branch I) General Surgery course on April 2015.

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INTRODUCTION

Thyroid surgery is one of the most commonly performed surgeries for benign and malignant conditions of the thyroid gland worldwide. The thyroid gland is closely related to many vital structures and hence poses a unique challenge to the surgeon.

Kocher and Billroth developed the method of knowledge to understand the physiology of the gland; both revolutionized the understanding of treatment of thyroid disease. Postoperative voice change after a partial or complete thyroidectomy is generally due to injury to the recurrent laryngeal nerve.(1–3) The external laryngeal branch of the superior laryngeal nerve, however, is also at risk due to its proximity to the superior pole of the thyroid gland. The external laryngeal nerve (ELN) innervates the cricothyroid muscle, which acts as the tensor of the vocal cord. Injury to the ELN will result in voice changes ranging from slight huskiness, poor volume and tired voice to inability to reach a high pitch that significantly has its effect on those who are professional voice users. The external branch of superior laryngeal nerve has a course close to the superior thyroid vessels and thus has a potential risk of injury

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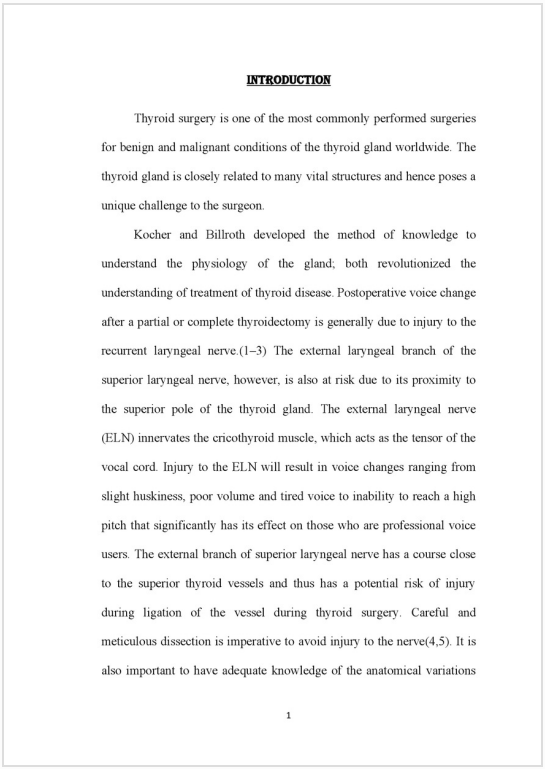

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ACKNOWLEDGEMENT

First I would like to give thanks to the God almighty whose blessing made this study possible.

I have absolutely no words to express my deep sense of gratitude and sincere thanks to my guide **Prof. Dr. D.MARUTHUPANDIAN M.S., F.I.C.S.,F.A.I.S** for his constant encouragement, help, invaluable guidance, moral support and blessings throughout my Post Graduation course, I thank both of them for helping me in selecting and preparing this dissertation.

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I thank the Dean of Madurai Medical College and Govt Rajaji Hospital, **Captain. Prof. Dr. B. SANTHAKUMAR M.Sc., M.D.,** for permitting me to conduct this study in the Department of General Surgery of the Govt Rajaji Medical college and Hospital, Madurai.

Last but not the least I am thankful to all my **Patients** without whom this study could not have been completed.

LIST OF ABBREVIATIONS

CT	Computed Tomography
DVT	Deep Vein Thrombosis
EBSNL	External Branch of Superior Laryngeal Nerve
EMG	Electro Myography
ESU	Electro Surgical Unit
FDG	Fluorodeoxyglucose
FNAC	Fine Needle Aspiration Cytology
IBSNL	Internal Branch of Superior Laryngeal Nerve
IDL	Indirect Laryngoscopy
IRMA	Immuno Radiometric Assay
ITA	Inferior Thyroid Artery
KTP	Potasium Titanium Phosphate
MIT	Mono Iodo Thyronine
MNG	Multi Nodular Goitre
MRI	Magnetic Resonance Imaging
NIS	Sodium Iodide Symport
PET	Positron Emission Tomography
PTH	Parathormone
RAI	Radio Active Iodine
RLN	Recurrent Laryngeal Nerve
RLND	Recurrent Laryngeal Nerve Dysfunction
SLN	Superior Laryngeal Nerve
SNG	Solitary Nodular Goitre
SSKI	Saturated Solution of Potassium Iodide
T3	Triiodothyronine
T4	Tetraiodothyronine
TBG	Thyroid Binding Globulin
TE	Tracheoesophageal
Tg	Thyroglobulin
TPO	Thyroid Peroxidase
TR	Thyroid Receptors
TSH	Thyroid Stimulating Hormone
TSHR	Thyroid Stimulating Hormone Receptor
USG	Ultrasonogram

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INTRODUCTION

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of the course of the nerve.I, IV and VI. Although most surgeons tend to avoid rather than to expose the nerve, injury of the low-lying ELN intertwining with the superior thyroid artery would be inevitable. The presence of a potential avascular space (space of Reeve) between the upper pole of the thyroid and cricothyroid muscle has been re-emphasized because it helps in making the external laryngeal nerve visible that's necessary for careful dissection(6). The aim of the present study was to analyse the frequency and types of ELN crossing this avascular space in relation to the structures of the upper pole of the thyroid and the related thyroid pathology.

In rapid succession, the understanding of altered physiology, advances in imaging, minimally invasive diagnostic and surgical techniques have taken place.

ABSTRACT

Background and Objectives

Thyroid surgery is known to its complications post operatively. In recent times these complications are reduced due to expertise in techniques and technologies. Injury to the external branch of the superior laryngeal nerve during thyroidectomy is common. Most of the surgeons do not have enough confidence to dissect and expose the nerve.

The aim of this study is to analyse the frequency and types of External branch of superior laryngeal nerve coursing through the space of Reeve in relationship to the upper pole of the thyroid and related structures.

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Methods

From November 2013 to September 2014 our study has been conducted which includes 30 successive patients undergoing (Hemi/Total) Thyroidectomy procedures and meeting the inclusion criteria in our surgical ward at GRH Madurai.

Results : A total of 30 thyroidectomies were done during the study period of which18 were total thyroidectomy and the remaining 10 were hemi thyroidectomy (8 left hemi thyroidectomy and 4 right hemi thyroidectomy). The frequency of the ELN documented crossing the reeve's avascular space were: **TYPE 1** nerve were 12 (24%) **TYPE 2A** nerve 28 (56%) and **TYPE 2B** 5 (10%). 5(10%) ELN were not seen despite an extensive search.

Conclusion : The preservation of the external branch of laryngeal nerve has various technical difficulties should be considered. Exposure and preservation of the nerve would be aided by the recognition of the potential avascular space of Reeve.in order to reduce the morbidity related to the thyroid surgery, every attempt should be made to ensure safe dissection. There is a considerable variation in the anatomical course of the nerve and its relation to various structures and are influenced by various factors. However every attempt should be made to identify the nerve through meticulous dissection by the surgeons in order to avoid the nerve injury.

Key words: Cricothyroid space, External laryngeal nerve, Thyroid surgery.

AIMS AND OBJECTIVES

To study the anatomy of external branch of superior laryngeal nerve in relation to superior thyroid vessels.

STUDY CRITERIA

INCLUSION CRITERIA:

All patients admitted in General surgical wards of Govt Rajaji Hospital with thyroid swellings being taking up for surgery are included in the study.

EXCLUSION CRITERIA :

Patients with

- proven thyroid malignancy
- recurrence

will be excluded from the study.

METHODOLOGY :

All patients admitted in General surgical wards of Govt Rajaji Hospital, from the time period from November 2013– September 2014 will be studied. Clinical features, symptomatology, investigations, operative findings, post- operative complications, morbidity and mortality will be studied according to the proforma.

ETHICAL CLEARANCE:

Approved by the Institute of Ethical Committee, Govt Rajaji Hospital.

ANALYSIS:

By statistical software SPSS version 15.0.

REVI EW OF LITERTURE

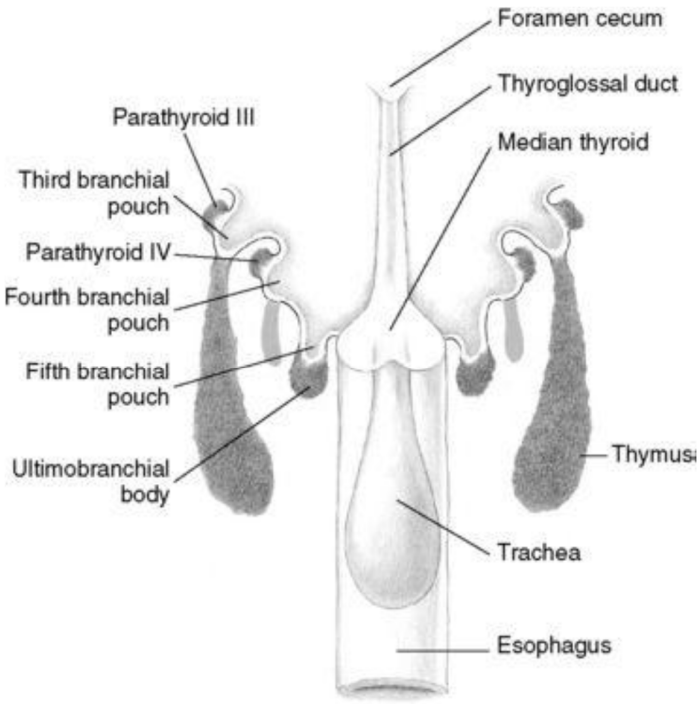
"The extirpation of the thyroid gland for goiter typifies perhaps, better than any operation the supreme triumph of the surgeon's arm"-William Halsted.

Thyroid Embryology and Developmental Abnormalities

The thyroid gland has a double origin form the primitive pharynx and the neural crest. The main body of the thyroid glands is derived from epithelial cells of the endoderm of the primitive pharynx(7,8). These cells will form the greater portion of the follicular elements of the thyroid tissue. They arise as a diverticulum from the midline of the pharyngeal floor. It soon develops as a bi-lobed, encapsulated structure that descends in the midline of the neck. With further development, this diverticulum remains attached to the buccal cavity by a narrow tract - the Thyroglosasal duct. Its distal end may become the pyramidal lobe. The most commonly encountered congenital cervical anomalies are Thyroglossal duct cysts. The thyroglossal duct lumen starts to obliterate from fifth week of gestation, and at the end of eighth week of gestation, duct disappears fully

The neural crest is the source of the parafollicular cells, or C cells, which secrete calcitonin. These C cells migrate form the neural crest of the ultimobranchial bodies of the fourth branchial pouch (P IV) and the

fifth branchial pouch. The incorporation of the fifth pouch with the P IV leads to the formation of the caudal-pharyngeal complex, which includes not only the ultimobranchial bodies, (lateral thyroids) but also the P IV. Eventually, C cells populate the thyroid tissue by way of its lateral lobes. which join the main body on each side



Midline ectopic thyroid rests are the result of the failure of or incomplete descent of the thyroglossal duct and of abnormal development of its epithelium(9,10). The most common example is the pyramidal lobe, which extends upward from the isthmus or forms either lateral lobe in about 30% of patients.

Surgical Anatomy of the Thyroid

The normal adult thyroid gland weighs about 17 g. It is wrapped around the anterolateral portion of the upper trachea and larynx. Either lobe occupies a space between the trachea and the esophagus medially; the carotid sheath posteriorly; and the sternocleidomastoid, the sternohyoid, and the sternothyriod muscles laterally and anteriorly.

If the sternothyroid and sternohyroid muscles are to be divided, they are transected high at the level of thyroid, to preserve their motor nerve, the ansa hypoglossi. Section of the strap muscles has no clinical functional consequence.

The normal thyroid is soft, dark wine-red in color, and covered by a thin capsule. It is loosely attached to neighboring structures. The variations in fixation of the gland may arouse suspicion of pathologic change, particularly when the history suggests acute thyroiditis or cancer. Normally the gland adheres only to the cricoids cartilage and the upper tracheal rings. This is the posterior suspensory ligament, or Berry's ligament

The superior thyroid artery arises from external carotid artery and inferior thyroid artery originates from thyrocervical trunk. Occasionally a branch from innominate artery or aorta, the arteria thyroidea ima artery. The external carotid artery gives of superior thyroid artery as its first branch. It gives off superior laryngeal artery and descends on the surface of inferior constrictor muscle.

It gives off anterior and posterior branch over the superior aspect of the thyroid gland. The anterior branch of the superior thyroid artery descends over the anterior border of the thyroid lobe and continues along the upper border of the isthmus to anastomose with its fellow of the opposite side. The posterior branch descends on the posterior border of the lobe and gets anastamosed with the ascending branch of the inferior thyroid artery(11,12).

The inferior thyroid artery, a branch of the thyrocervical trunk runs upwards, medially, and then downwards and reaches the lower pole of the gland. During its course, it passes behind the carotid sheath and the middle cervical sympathetic ganglion; and in front of the vertebral vessels; and gives off branches to adjacent structures. Its terminal part is intimately related to the recurrent laryngeal nerve. The

artery divides into 4 or 5 glandular branches which pierce the fascia separately to reach the lower part of the gland. One ascending branch anastomoses with the posterior branch of the superior thyroid artery, and supplies the parathyroid gland.

It is often said that the superior thyroid artery supplies the upper one third of the lobe and the upper half of the isthmus; and that the inferior thyroid artery supplies the lower two thirds of the lobe and the lower half of the isthmus. However, the inferior and superior thyroid arteries anastomose freely both on the surface of the gland as well as in its substance; and the territories supplied by the two arteries overlap considerably.

Sometimes (in 3% of individuals) the thyroid is also supplied by the lowest artery (thyroidea ima artery) which arises from the branchiocephalic trunk or directly from the arch of the aorta. It enters the lower part of the isthmus. Accessory thyroid arteries arising from tracheal and oesophageal arteries also supply the thyroid.

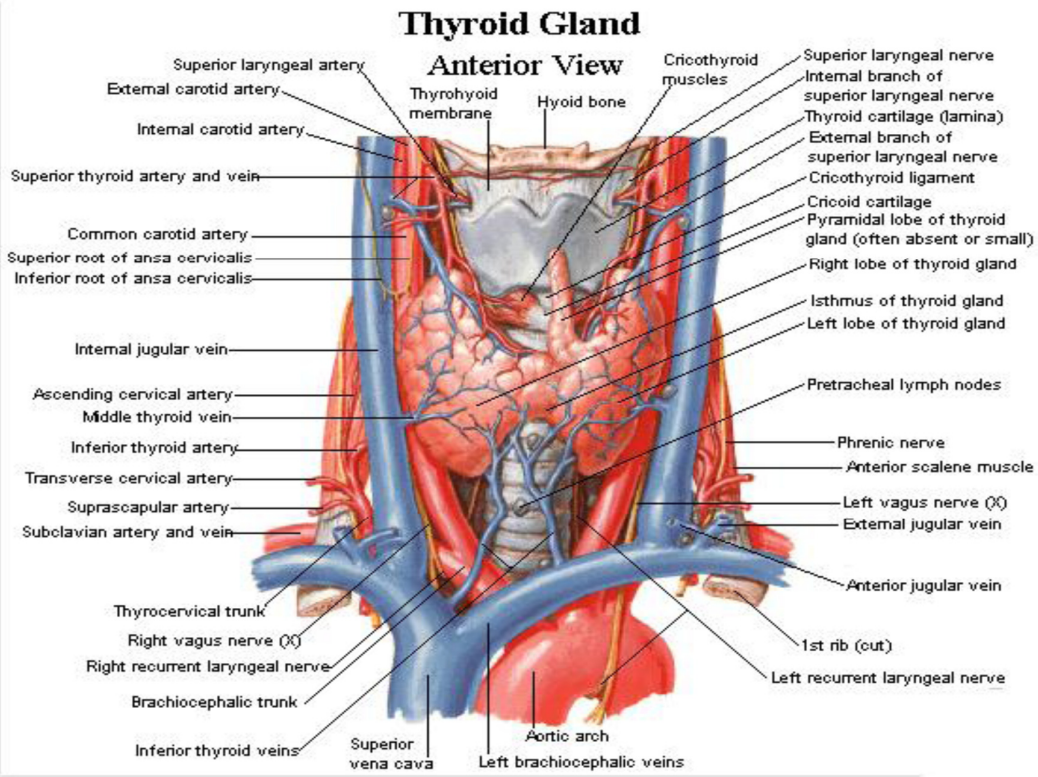
VENOUS DRAINAGE

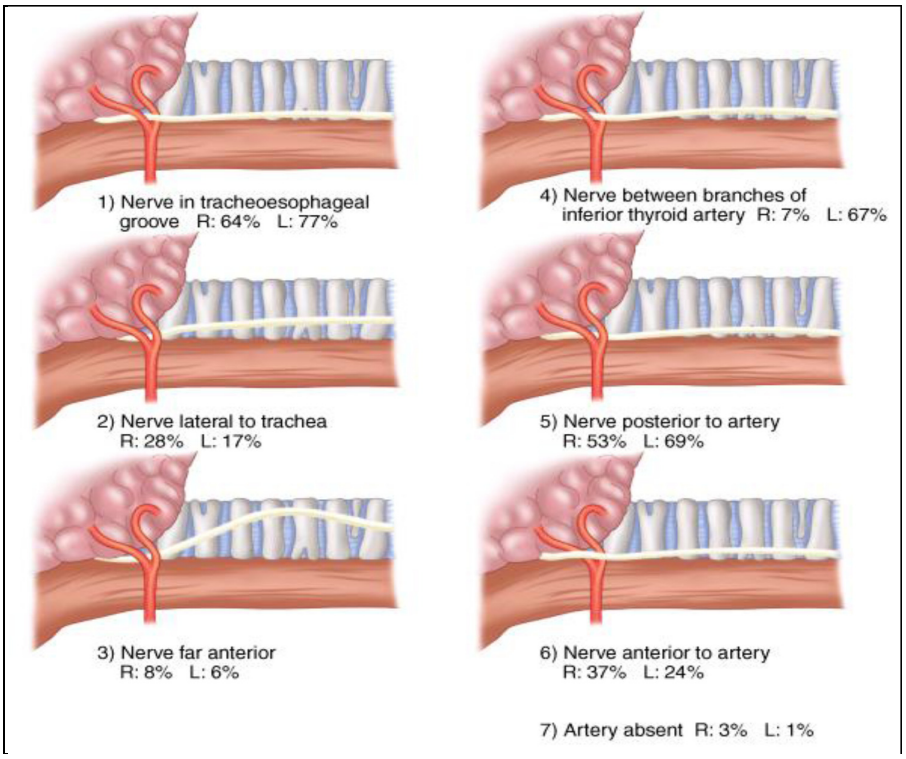
The thyroid is drained by three veins namely superior thyroid vein, middle thyroid vein and inferior thyroid vein. The superior thyroid vein emerges at the upper pole and accompanies the superior thyroid artery it ends either in the common facial vein or internal jugular vein. The middle thyroid vein is a short wide channel which emerges at the middle of the lobe and soon enters the internal jugular vein. The inferior thyroid vein emerges at the lower border of the isthmus. They form a plexus in front if the trachea, and empties into the left brachiocephalic vein. A fourth thyroid vein (of Kocher) may emerge between the middle and inferior veins, and drain into the internal jugular vein.

LYMPHATIC DRAINAGE:

The relationship of the thyroid gland to its lymphatic drainage is most important when considering surgical management of carcinoma of thyroid. The thyroid gland and its neighboring structures have rich lymphatics that drain the thyroid in almost every direction. Within the gland, lymphatic channels are present immediately beneath the capsule and communicate between lobes through the isthmus. This drainage connects to structures directly adjacent to the thyroid, with numerous lymphatic channels into the regional lymph nodes.

Clinically it is useful to divide the lymph nodes between the central and lateral neck; the boundary between them is marked by the carotid sheath. The lateral neck zones are further subdivided. Most thyroid cancers drain directly to central nodal basins except in superior third of the gland, which may drain directly to the lateral compartment.

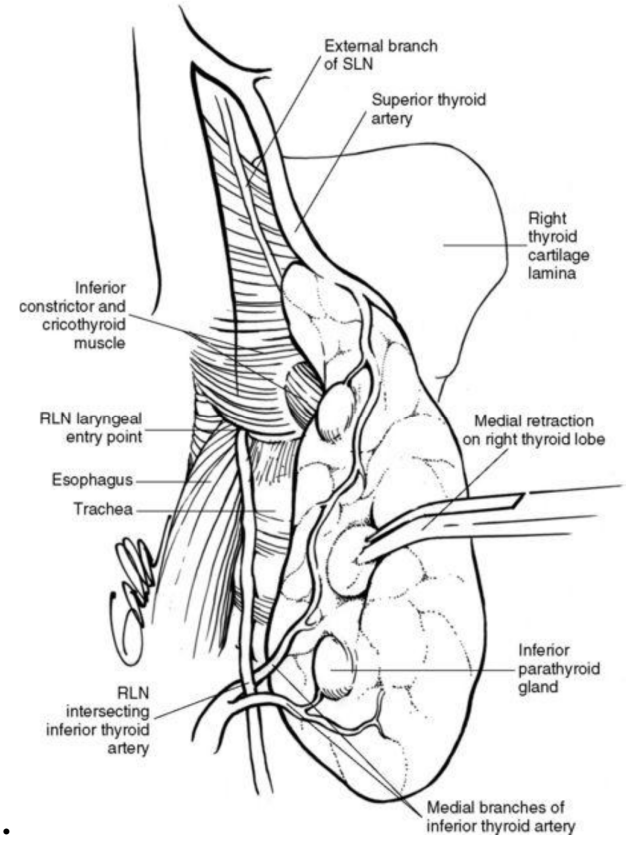


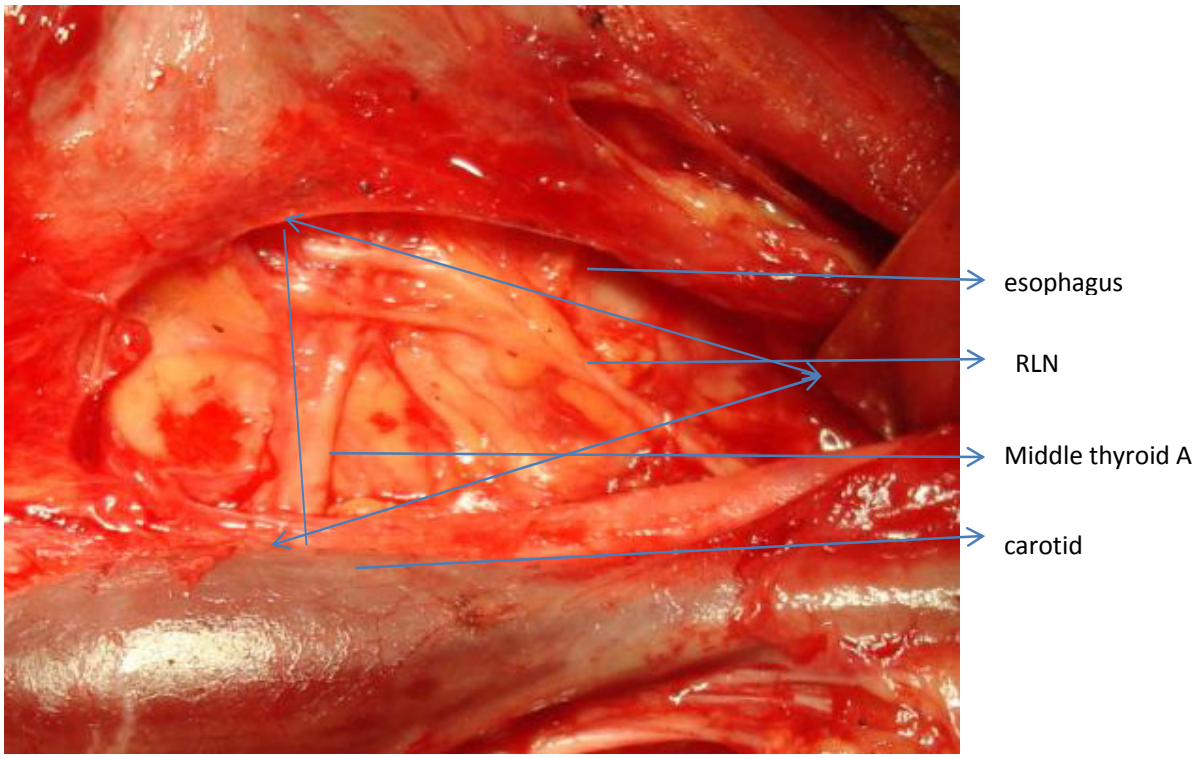


The right recurrent laryngeal nerve.

The right recurrent laryngeal nerve arises from the cranial nerve X, the vagus in the front of the right subclavian artery and winds backwards below the artery, and they runs upwards and medially behind the subclavian and common carotid arteries to reach the trachea oesophageal groove. In the upper part of the groove it is related to the inferior thyroid artery. It may be superficial or deep to the artery. Occasionally, some branches are in front of the nerve, and some are behind it. The nerve then passes deep to inferior constrictor lower border, and enters the larynx behind the cricothyroid joint. It supplies: a) intrinsic muscles of the larynx, except the cricothyroid, b) sensory nerves of the

larynx below the level of the vocal cords c) cardiac branches to the deep cardiac plexus, d) branches to the trachea and branches to oesophagus, and e) to the inferior constrictor muscle. The cardiac branches are superior and inferior. Out of the four cardiac branches of the vagi (two on each side) the left inferior branch goes to the superficial cardiac plexus. The other three cardiac nerves go to the deep cardiac plexus(13,14).





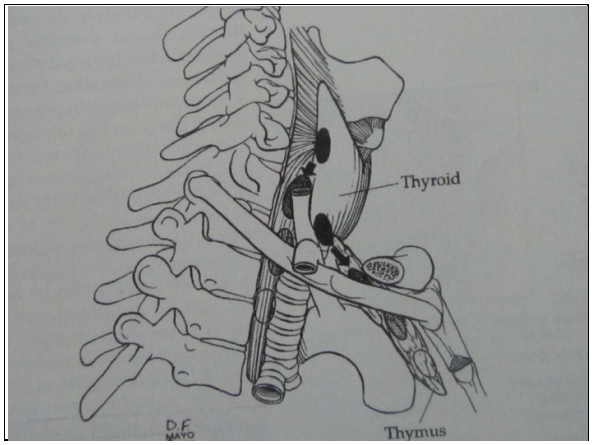
SIMON'S TRIANGLE

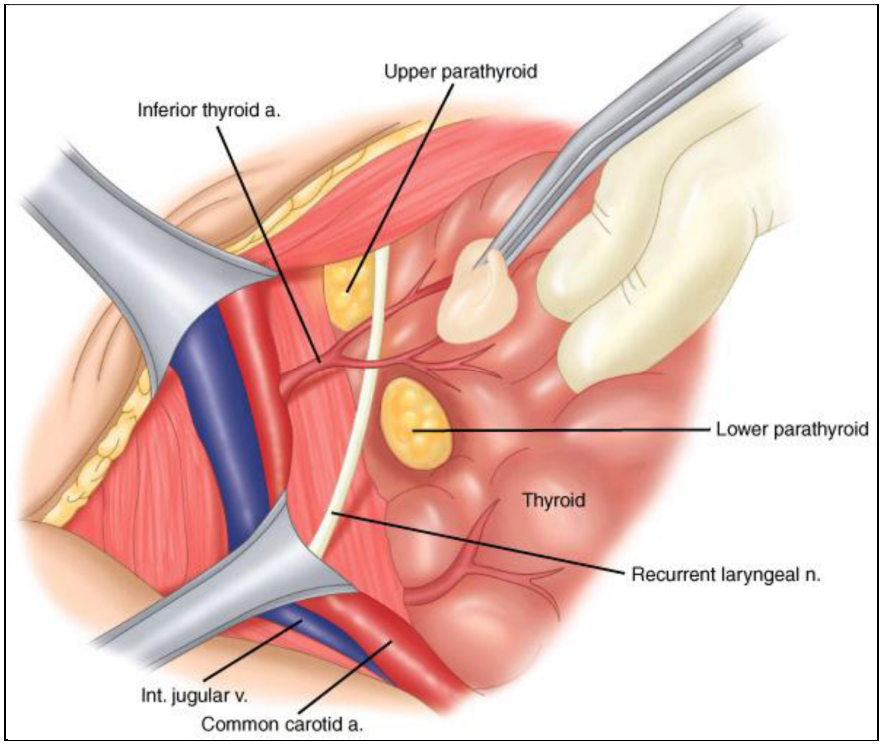
THE LEFT RECURRENT LARYNGEAL NERVE

The recurrent laryngeal nerve on the left arises from the vagus in the thorax, as the latter crosses the left side of the arch of the aorta. It loops around the ligamentum arteriosum and reaches the trachea oesophageal groove. Its distribution is similar to that of the right nerve. It does not have to pass behind the subclavian and carotid arteries, and usually it is posterior to the inferior thyroid artery(15,16). The anatomical landmark to identify the right recurrent laryngeal nerve is the triangle by name Simon triangle. The boundary of this triangle is bounded medially by the esophagus, laterally by the carotid artery and the base is formed by the middle thyroid vessels.

PARATHYROID GLAND

The parathyroid glands develop from Branchial Pouches III and IV. The superior parathyroid glands develop from Pouch IV, travel a shorter distance than the inferior glands, and are typically located along the posterior border of the thyroid gland at approximately 1 cm superior to the entrance of the inferior thyroid artery. Because of this location, when the superior glands descend further, they almost always remain posterior, in the tracheoesophageal groove or retroesophageal space(17). The location of the inferior gland can range from being high, anterior to the carotid artery to being in the anterior mediastinum within the thymus Inferior glands associated with the thyroid gland usually remain anterior to the recurrent laryngeal nerve, whereas the superior glands are found dorsal to the nerve.





There is an extremely close relationship between superior thyroid artery and external laryngeal nerve. The nerve is the sole motor supply to cricothyroid muscle which is a tensor of the vocal cord. This nerve has high risk of injury during superior pole ligation(18,19).

To avoid nerve injury while ligating the superior thyroid vascular pedicle, it is recommended not to ligate the main trunk as a whole but to identify the branches and then dissecting it .The superior thyroid arteries should be ligated as low as possible. Secondly it is advisable to dissect the superior thyroid vessels. The dissection requires strong downward and outward traction of the thyroid upper pole. The dissection must be performed from medial to lateral.

The inferior thyroid artery and its end branches intimately associated with recurrent laryngeal nerve at above the level of junctions of lower and middle third of thyroid gland. The left recurrent laryngeal nerve ascends at the depth of tracheo-oesophageal groove. The right recurrent laryngeal nerve courses more obliquely somewhat more lateral in position caudally. The recurrent laryngeal nerve continues upward and medially and at the postero lateral aspect of middle third of thyroid gland and is extremely close to capsule of thyroid. The recurrent laryngeal nerve is accompanied by inferior laryngeal artery.(20,21) The site near berry's ligament, this artery is usually just posterior to recurrent laryngeal nerve and divides to give multiple small branches that cross the nerve to enter the thyroid gland. The recurrent laryngeal nerve is motor nerve to intrinsic muscles of the larynx. Injury to motor trunk causes paralysis of vocal cord on the ipsilateral side. The other extra laryngeal branches are sensory.

Non recurrence of the inferior laryngeal nerve is due to vascular anomaly of aortic arches during the embryonic development- no innominate artery but an aberrant subclavian artery. Nerve anomaly on the left side requires in addition a right aortic arch associated with situs inversus. A non recurrent laryngeal nerve has been also reported in association with an ipsilateral recurrent laryngeal nerve.

The most critical structure that is to be kept in mind when dividing the vessels of superior pole is the external laryngeal nerve. This nerve has been referred as neglected nerve of thyroid surgery. Injury to it may easily be overlooked because they are difficult to diagnose at laryngoscopy and because the initial symptoms are minimal and regarded as natural post operative voice disturbance without injury to recurrent laryngeal nerve.

THYROID RESTS

Thyroid rests are isolated rests of normal thyroid tissue which may lies below the lower pole of thyroid within the upper anterior mediastinum or within the line of thyrothymic tract(22,23)

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Grade I : thyroid rests consists of thyroid tissue protrusion arising from thyroid gland the inferior aspect in the region of thyrothymic ligament.

Grade II: thyroid rests include thyroid tissue lying within the thyrothymic tract and attached to thyroid proper.

Grade III : thyroid rests are similar to grade II but are attached to thyroid gland by a fibrovascular core.

Grade IV: no connection to thyroid gland.

SUPERIOR POLE AND SLN

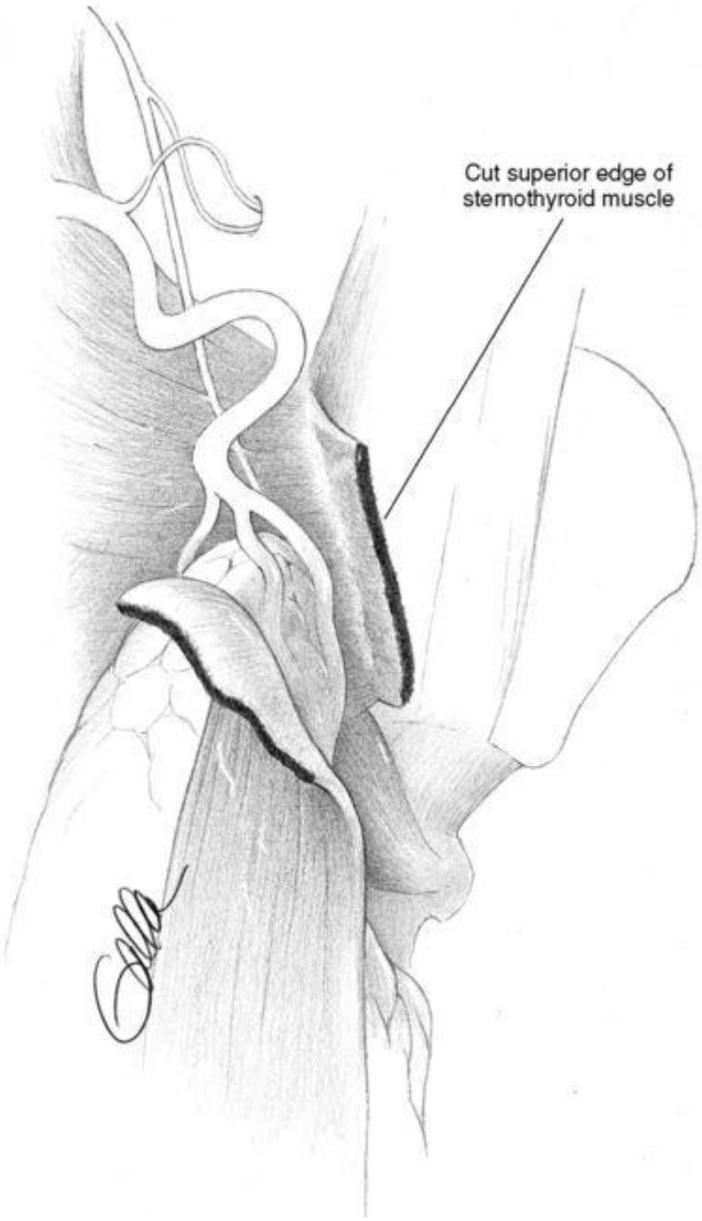
Keeping the superior pole in the final phase of lobectomy allows the superior pole to be managed after the superior parathyroid has been reflected on a good vascular pedicle. Given its dorsal location, dissection of the superior parathyroid gland is necessarily kept until a final phase of surgery. Once this gland is reflected posterolaterally and preserved, the superior pole can be aggressively mobilized and downwardly retracted and the superior pole vessels can be dissected with optimal exposure afforded for the external laryngeal nerve.

As the superior pole vessels are dissected, downward mobilization of the gland is facilitated by Mayo clamp on the superior pole parenchyma facilitating downward retraction. If the superior pole is enlarged significantly or when the dissection is difficult, the following two steps can be taken to improve superior pole exposure. The first is transection of sternothyroid muscle. This muscle tends to hood the superior pole as it extends to insert on oblique line of thyroid cartilage superiorly. Lateral retraction of sternohyoid muscle and medial retraction on thyroid laryngotracheal complex allows visualization of discrete muscle band as it extends medially to its laryngeal insertion. The transected muscle need not be re-approximated. The laryngeal head of the sternothyroid muscle on its insertion is a very robust indicator of the

position of external laryngeal nerve as it runs down posteriorly on the inferior constrictor muscle. Patient does not experience additional pain, edema or drainage from this mini strap division(24).

The second manoeuvre for superior pole dissection involves divison of the isthmus and ligament of berry dissection allowing the thyroid to be supported only by superior pole attachment. The vessels of the superior pole should be taken individually to control optimally and avoid risk to external branch of laryngeal nerve injury(25).

The superior laryngeal nerve branches from the vagus high in the neck running deep to external and internal carotid arteries. It can be visually identified in 80% cases and 100% through electrical stimulation virtually. It innervates both vertical and oblique portions of cricothyroid muscle which is a primary tensor. A 20% to 20% rule can be considered for the superior laryngeal nerve. 20% of the time it is deep to deep fascia of inferior constrictor muscle and 20% of time it extends caudally interacting with superior pole vessels, placing it at risk as the superior pole vessels are controlled(26,27).



In anatomy textbooks, the EBSLN is described as passing just superficial to inferior pharyngeal constrictor muscle and piercing it to supply cricothyroid muscle. Various landmarks have been described to identify the EBSLN in thyroid surgery. As described by Stell and Maran, the nerve lies in the Joll's triangle. The sternothyrolaryngeal triangle of

Joll is formed by the superior pole of the thyroid gland laterally and the thyroid vessels in the superior pole, superiorly by the attachment of the strap muscles to the thyroid cartilage and the midline medially. On the floor of the triangle is formed by cricothyroid muscle which is supplied by the EBSLN.

Different identification rates of the EBSLN have been quoted by authors with few not performing routine identifications The techniques used for the identification of the EBSLN mentioned in literature include the use of nerve stimulator, the inspection of the distal part of the inferior constrictor muscle and individual ligation of the superior thyroid vessels The principle of any surgery is the identification of any structure in order to preserve it. This applies to identification of the EBSLN as well.

SURGICAL ANATOMY OF EXTERNAL LARYNGEAL NERVE

Little attention was paid initially to the surgical anatomy of external branch of superior laryngeal nerve during beginning of 20th century. In fact Kocher did not specifically mention this nerve in his book the importance of the preservation of the external branch of superior laryngeal nerve was made clear as a result of thyroidectomy performed in 1935. At that time Amelita galli curci was the most famous soprano of the world. She underwent a thyroidectomy under local anaesthesia to be sure

that her recurrent laryngeal nerve was not damaged. However her vocal registry postoperatively lowered since the time, the EBSLN has been known as the nerve of Amelita galli curc(i28,29,30).

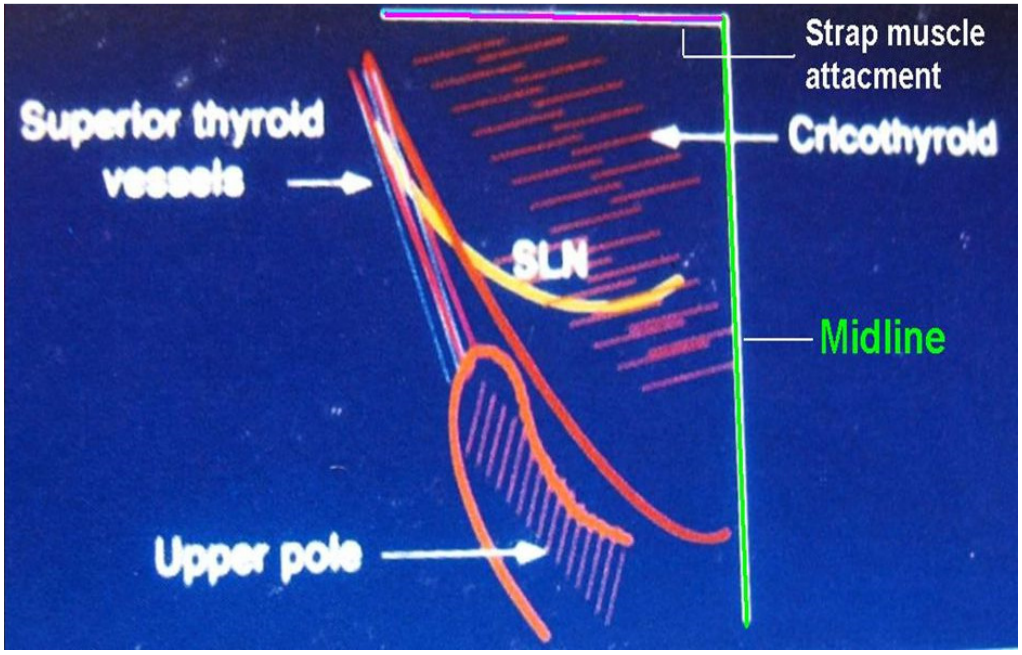
The superior laryngeal nerve is a branch of vagus, the tenth cranial nerve.it separates at level of no dose ganglion from vagus, about 4cm cranially to carotid artery bifurcation. The superior laryngeal nerve divides into external branch and internal branch about 1.5cm inferiorly. the external branch descends dorso laterally to the carotid vessels, crosses

them medially, extending to the larynx .the nerve is 0.8mm wide and length varies from 8.0 to 8.9cm.

Joll's triangle or the sterno thyro laryngeal triangle is described as the identification for the external laryngeal nerve. The boundaries of the triangle are superior pole of the thyroid and the superior thyroid vessels laterally, attachment of the strap muscles to the thyroid cartilage superiorly and midline as the medial boundary.

JOLL'S TRIANGLE

The surgical importance of this nerve relates to its proximity to the superior vessels of the thyroid. The external branch of superior laryngeal nerve crosses the superior thyroid vein and artery well above the superior border of thyroid. Only 80% of the external branch of superior laryngeal nerve were identified during the procedure of thyroidectomy and in remaining 20% the nerve could not be identified due to its location within the fibres of inferior constrictor muscle.

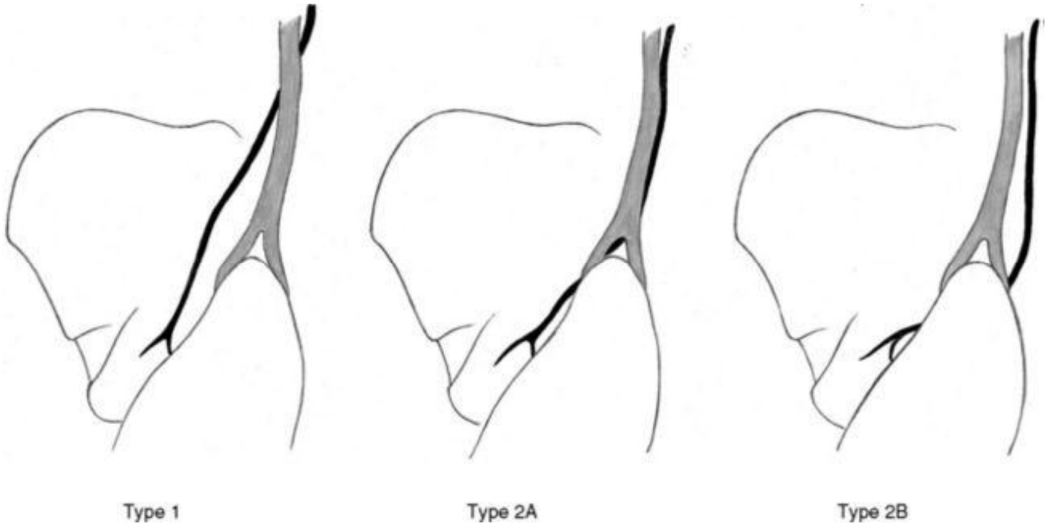


There is a relation between the nerve, superior thyroid vessels and superior thyroid pole which classifies the surgical anatomy of the nerve into three types(31)

Type I: the nerve crosses the superior thyroid vessels 1 or more cm above the horizontal line that passes through the upper border of the superior pole of thyroid.

Type II a: in this type the crossing of the nerves over the vesses is less than 1 cm above the horizontal plane.

Type II b: the crossing of the nerve over the vessels is less than 1 cm below the horizontal plane.



Of the above three types type IIb nerves has the highest risk of iatrogenic damage.

Kierner et al published a similar of external branch of superior laryngeal nerve classification adding a fourth category in which the nerve runs quite dorsally to the superior thyroid pedicle making the identification of the nerve more difficult(32).

Kierner classification	
Type I	Crosses STA > 1 cm above upper pole of thyroid
Type II	Crosses STA < 1 cm above upper pole of thyroid
Type III	Crosses STA under cover of upper pole of thyroid
Type IV	Descends dorsal to artery and crosses STA branches immediately above upper pole of thyroid

Friedman et al proposed a different type of external branch of superior laryngeal nerve anatomy classification focusing on the relationship between the nerve and the inferior constrictor muscle at its junction to the cricothyroid(33).

Type 1: The nerve is superficial to the inferior pharyngeal constrictor muscle.

Type 2: The nerve penetrates the lower part of the inferior constrictor muscle.

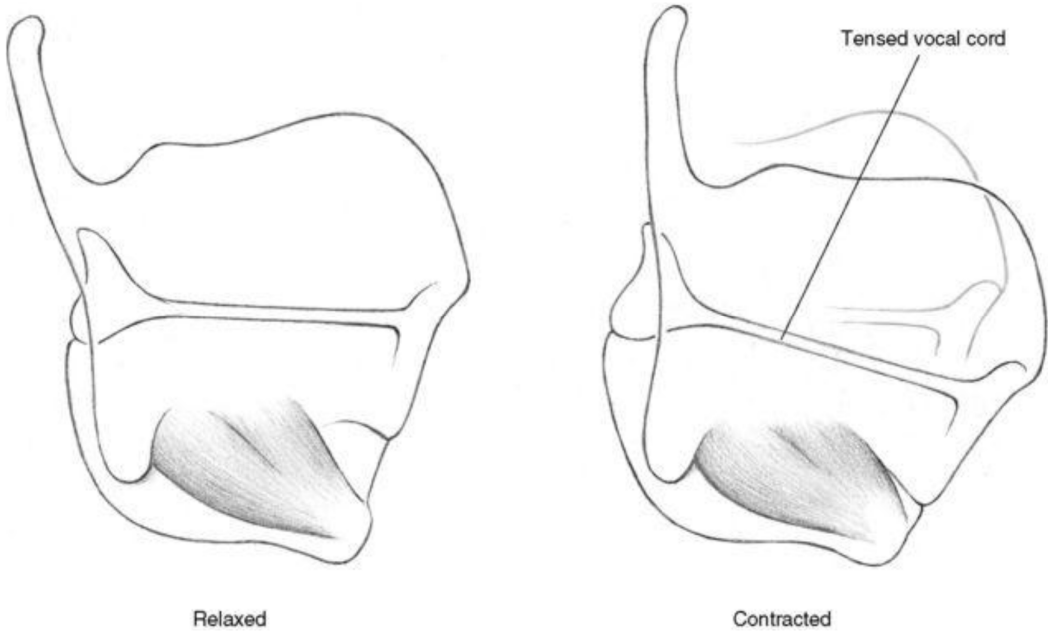
Type 3: The nerve runs deep to the inferior constrictor muscle.

The Type 3 variant is the fact that many surgeons state that the reason for not identifying the nerve in the zone of the upper pole of thyroid gland during thyroid surgical procedure.

PHYSIOLOGY AND PATHOPHYSIOLOGY

External branch of superior laryngeal nerve is the only motor supply to cricothyroid muscle. The cricothyroid muscle has two bellies: pars recta and pars oblique. The work action of the two subunits is not fully understood but combined contraction of these two components is vital in adjusting the vocal fold tension and length. The frequency of vocal fold vibration is determined by the vocal fold tension which in turn is controlled largely by balance between these two muscle action: the

thyroarytenoid muscle which tends to shorten the fold length and the cricothyroid muscle. The cricothyroid muscle promotes elevation of the cricoid cartilage which shortens the distance with the thyroid cartilage. This motion of the cricoid cartilage increases the tension of vocal fold and its length. This cricothyroid muscle induced vocal cord tension is termed as external tension of vocal cord, compared with the more refined increase in internal tension which occurs due to the action of thyroarytenoid muscle. The cricothyroid induced vocal cord tension is thought to be of highest importance in production of high frequency sounds during phonation. Besides it has some role in respiration mainly during expiration(34,35).

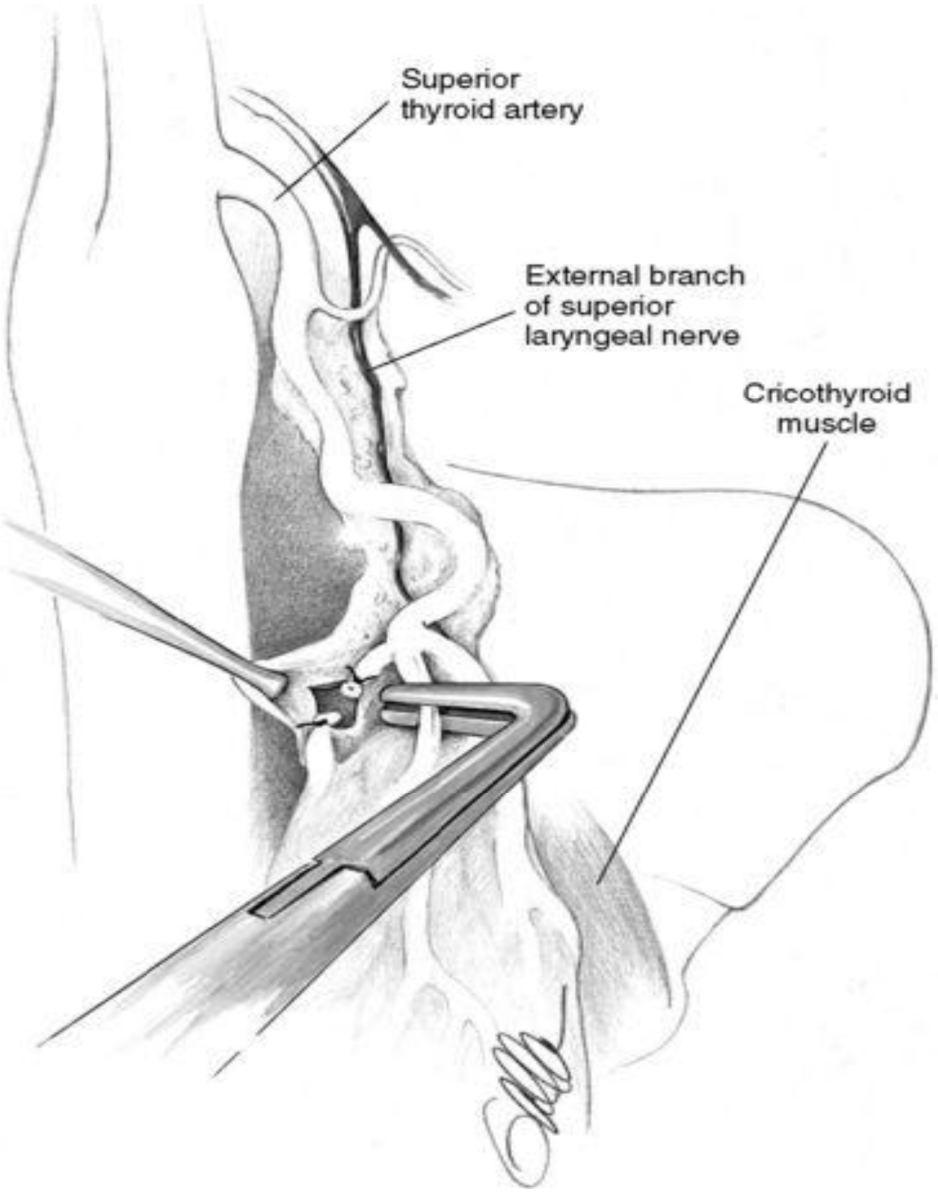


The injury of external branch of superior laryngeal nerve causes complete cricothyroid muscle paralysis which can be identified by electrical silence at electromyography. Functionally the fundamental frequency of the voice is lowered and the voice performance gets worsened markedly, especially in high frequency sounds.

SURGICAL TECHNIQUE

The surgical approach of the superior pole of thyroid is most necessary in operations involving in the thyroid gland. The dissection of the superior thyroid pole should start with mobilization of thyroid lobe as a whole. The middle thyroid vein ligation is advisable which helps in facilitation of initial mobilization.

It is necessary to completely expose the sterno-thyroid-laryngeal triangle before any superior pole suture is placed. In most cases, if there is normal thyroid lobe of normal size or minimally enlarged, there is no necessitation of complete section of strap muscles. However, partial incision on sternothyroid with cautery will improve the access to superior thyroid pedicle(36).



The superior thyroid vessels usually divide into three branches that embrace superior thyroid pole: two branches are located anteriorly and one dorsally to the superior pole

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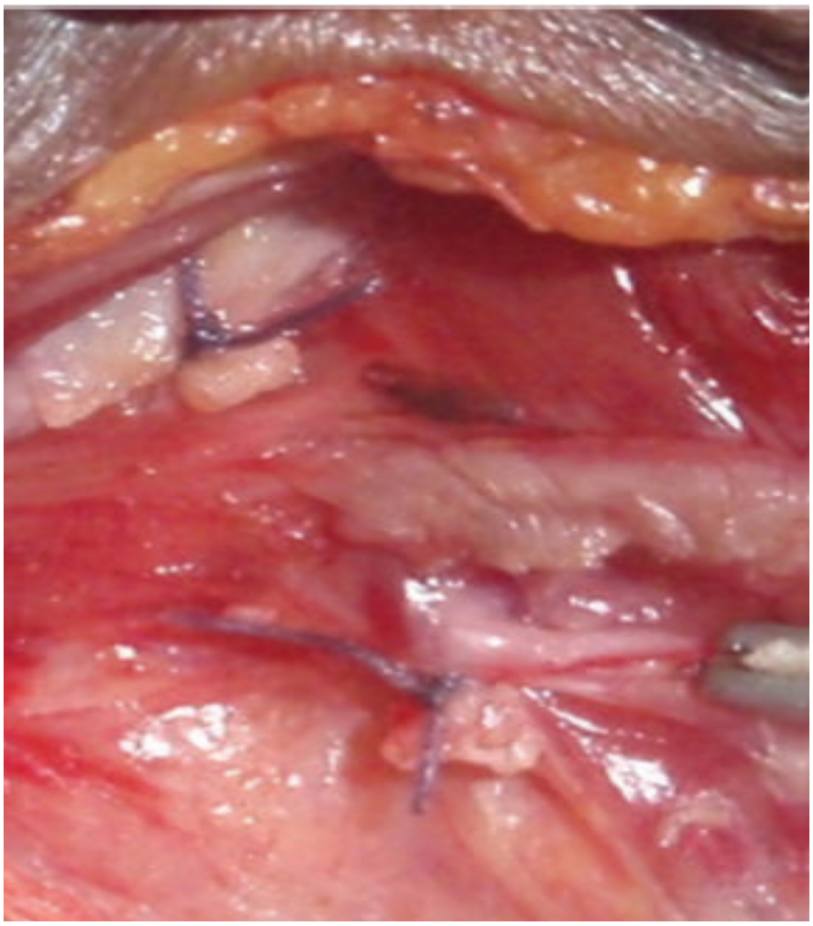
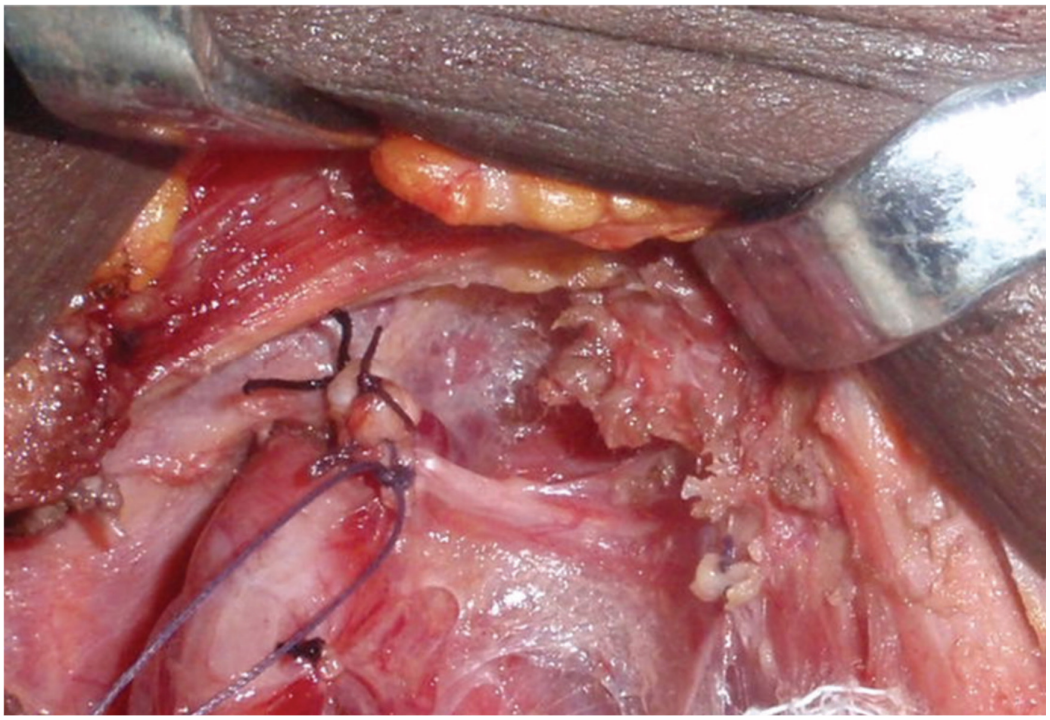
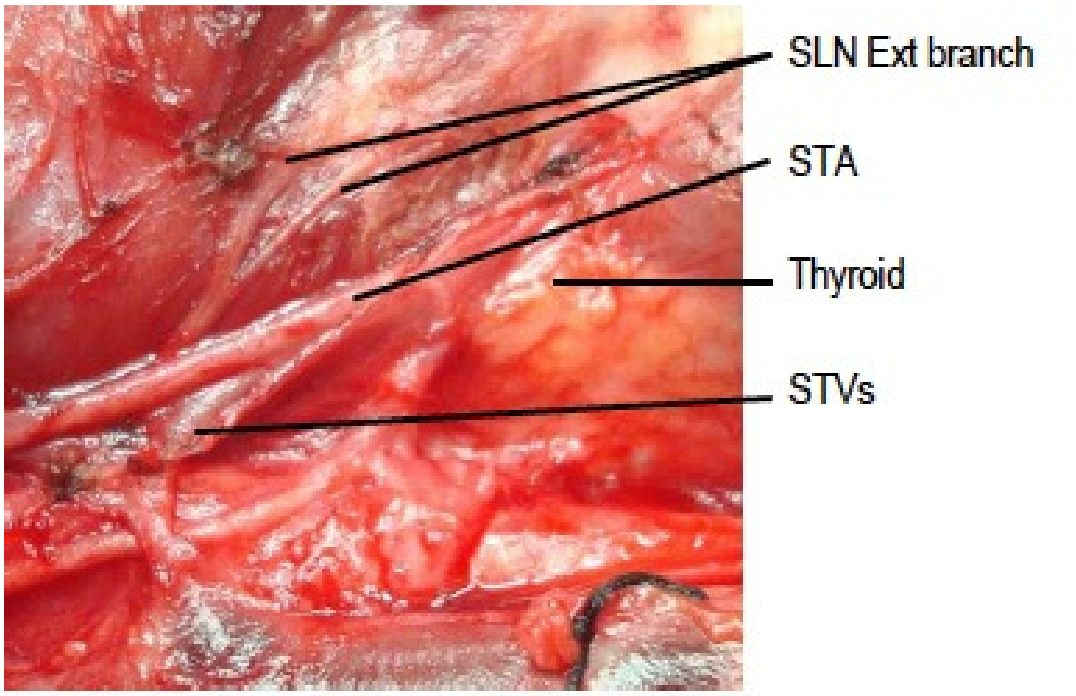


It is necessary to dissect and ligate these two branches individually and placing the sutures as caudally as possible. Sometimes, gentle traction of the thyroid lobe caudally helps preserving the integrity of the nerve. Generally this nerve is located cranially to the superior border of thyroid lobe which offer reasonable protection to the nerve.



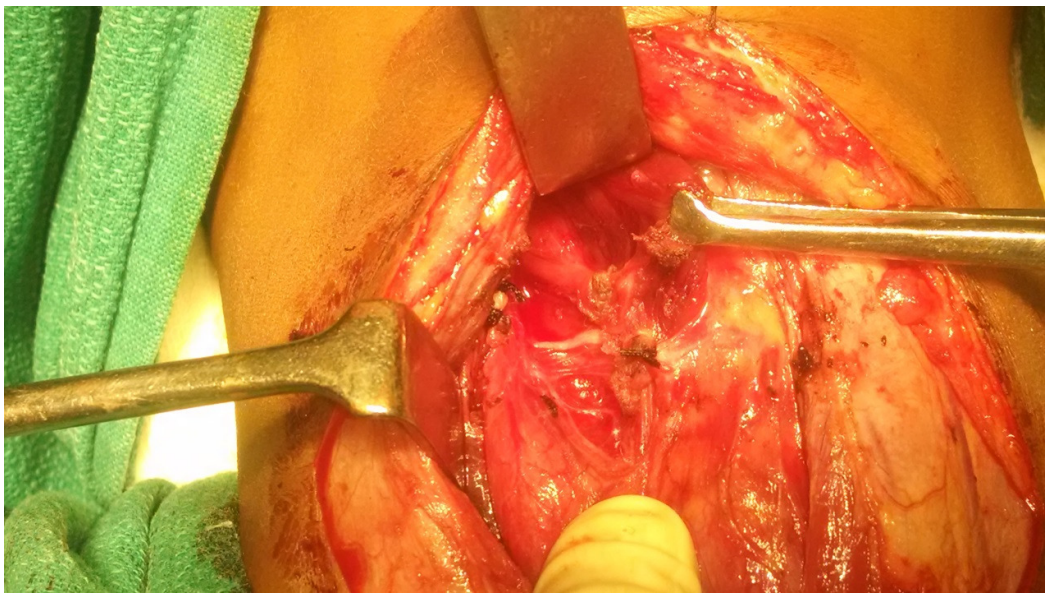
The surgeon should have a low threshold use of nerve stimulator while dissecting this area. When the nerve is stimulated electrically, quick and powerful contractions of the cricothyroid is obtained. Once the external nerve is visualized, it should be kept at constant direct vision during the entire superior pole dissection.

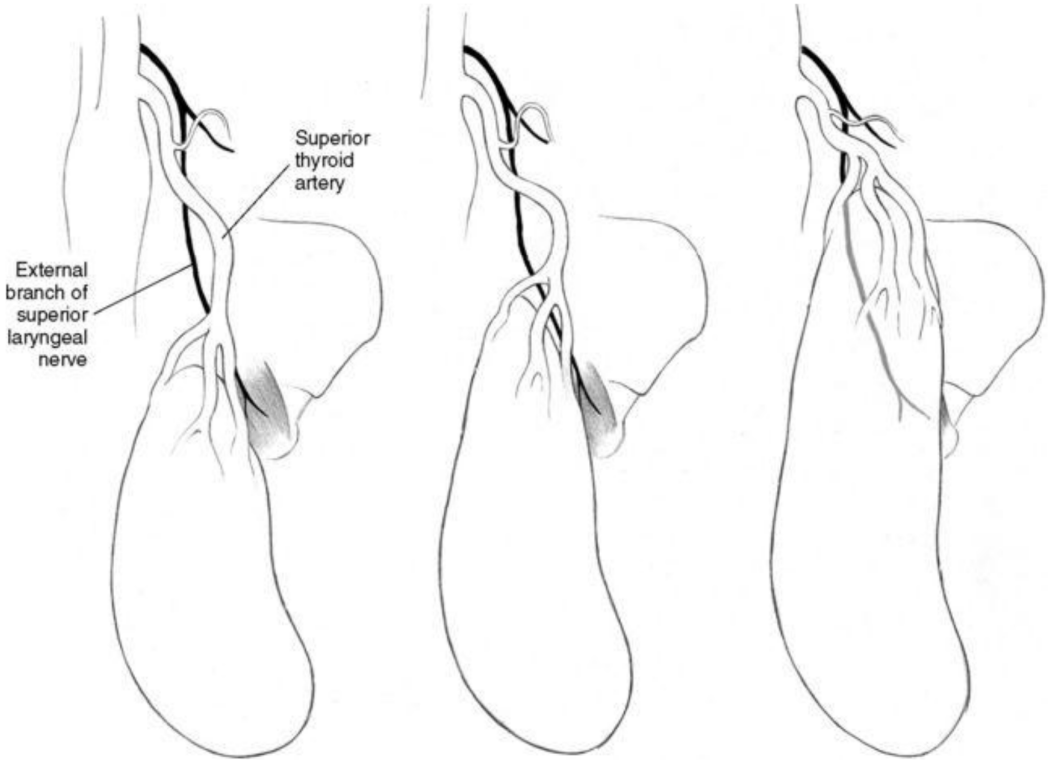


Advantage in using the nerve stimulator in external branch of superior laryngeal nerve management is its ability to stimulate the nerve superiorly and even if the nerve is subfascial within the fibers of inferior constrictor, we can get a positive signal.

The positive response results with cricothyroid twitch as well as small response on endotracheal monitoring systems which can be seen through human communicating nerve(37).

Dissection of superior thyroid pole is more difficult in dealing with a large goiter. In this instance the upper pole border is markedly elevated which puts the upper pole in close contact with the nerve. Additionally there will be superior thyroid vessel enlargement which parallels the dimensions of the goiter and demanding more careful dissection. The sectioning of the strap muscles offers a better and safer exposure.





DIAGNOSIS OF SUPERIOR LARYNGEAL NERVE PARALYSIS

The diagnosis of external branch of superior laryngeal nerve palsy is not easy to confirm based on endoscoping and clinical findings. The notable changes are subtle voice especially in the male patients. However, in women and voice professionally, some symptoms are common.

1. Lowering of fundamental frequency
2. Inability to produce high tone sounds
3. Vocal fatting at the end of day

4. Shortening of the phonic time of consonants
5. Lowering of high tones
6. Contraction of vocal range

Video laryngeo stroboscopy can be used in diagnosis of external laryngeal nerve paralysis after thyroidectomy. The paralysis of the nerve results in

1. the vocal cord bowing
2. rotation of the posterior glottis towards the paralytic side
3. displacement of affected vocal cord inferiorly
4. vocal fold mucosal wave asymmetry

Most objective method for external laryngeal nerve injury detection is the electromyography of the cricothryoid muscle using the thyroid cartilage inferior border and superior aspect of cricoid cartilage as anatomical landmarks externally. Electrodes are placed per cutaneously over the muscle. The patient is asked to produce high tone. If there is no nerve injury, increase in electrical activity of cricothryoid muscle is noted. If there is injury to the nerve, no background electrical activity is observed. Contralateral muscle can be used as control. Electromyography is an invasive and painful technique that should not be used routinely(38).

INCIDENCE OF EBSLN INJURY

Lore et al reported 0.9% injury in 111 patients employing only indirect laryngoscopy. Smith et al found 2.6% injury in 13 patients prospectively. Randolff clinical trial 12-28% of injury were not identified intra operatively. Some of these were permanent as confirmed by electro myographic evidence(39,40).

TREATMENT OF EBSLN INJURY

Unfortunately once the nerve gets injured, no true elective treatment is available. Intensive phono therapy is highly recommended. The paralysis is permanent. The consequence in the career of a voice professional might be significant. Laryngoplasty might be useful in such situations(41).

Results in other studies

The external branch of superior laryngeal nerve has a close anatomical relationship with the superior thyroid pedicle and in 15 – 20% of cases the nerve may be type IIb in which the nerve crosses the superior thyroid vessels below the upper border of superior pole of thyroid. In these instances it may be at risk during thyroidectomy. So, it is always advisable to ligate the superior thyroid vessel separately and as close as

possible. And in case any nerve is found in this area, a positive identification with nerve stimulator is extremely useful.

The EBSLN is another argument to use nerve monitoring during thyroidectomy, especially on a enlarged thyroid lobe. The only effective way of avoiding paralysis of the nerve which can be extremely un favourable for a voice professional is comprehensive anatomic knowledge about the nerve and gentle handling of the superior thyroid pole.

RLN-SLN CONNECTIONS

To understand the functional significance of extra laryngeal branching and for interpreting intra operative RLN monitoring information, the surgeon needs to understand not only the anatomy of the RLN and SLN systems but also the interconnections. The SLN internal branch chiefly innervates the afferent part of the hypo pharynx, base of tongue, supra glottis and vocal cords. The external branch of the superior laryngeal nerve provides motor function to cricothyroid muscle and innervates sensory part of the anterior sub glottis. The efferent activity is important in regulating the laryngeal protective mechanism which results primarily in SLN internal branch. Many regard the RLN SLN connection as a primary anastamotic connection between the distal sensory part of the

superior laryngeal nerve and recurrent laryngeal nerve. Some believe there may be a possible motor component within SLN branches. Galen and Martin believed that return of the voice that sometimes occurs after transection of RLN may result from regrowth from SLN branches. More recently, it has been suggested that a method of vocal cord recovery after an RLN injury should involve re innervation through supplemental motor branches of SLN(42). Functionally the SLN and RLN system interconnection can be divided into four groups:

1. Galen' s anastomosis
2. SLN external branch/ distal RLN anastomosis known as human communicating nerve
3. Inter arytenoid anastomosis
4. SLN internal branch - RLN thyro arytenoid regional anastomosis

SLN MONITORING

Damage to external branch of superior laryngeal nerve results in voice changes significantly which are typically described as pitch reduction, inability to attain higher registers, decreased voice projection. Most time, glottic examination of external branch paralysis or paresis can be virtually normal. Robinson in a study of 35 patients with laryngeal

electromyographic study documented SLN paralysis or paresis found significant decrease in

- maximum phonation time,
- frequency range
- increased, jitter, shimmer , noise to harmonic ratio and increased flow rate.

In 20% cases the external branch of the nerve is hidden beneath the inferior constrictor muscle and therefore not seen directly. Despite this surgical anatomy, a nerve stimulator can be passed along the inferior constrictor and discrete pitch of cricothyroid muscle can be elicited as the stimulator passes the external branch. An exact landmark for linear oblique part of external laryngeal nerve as it courses down along the inferior pharyngeal constrictor towards the cricothyroid muscle is the laryngeal head of sternothyroid muscle. Within 1-3 mm of this obliquely oriented laryngeal line, the external branch of superior laryngeal nerve can be found with a high degree of certainty. Blind stimulation of the nerve in this area with a nerve stimulator uniformly shows identification of the linear path. EMG monitoring with endotracheal tube recording electrode, EMG data may be less critical for SLN than for RLN because the cricothyroid pitch is usually apparent. The average SLN wave form amplitude was 269 millivolt. The threshold for SLN stimulation was 0.5

mA. There was no significant difference in waveform characteristics suggesting surgical dissection and current stimulating did not adversely affect electrophysiology of neural function

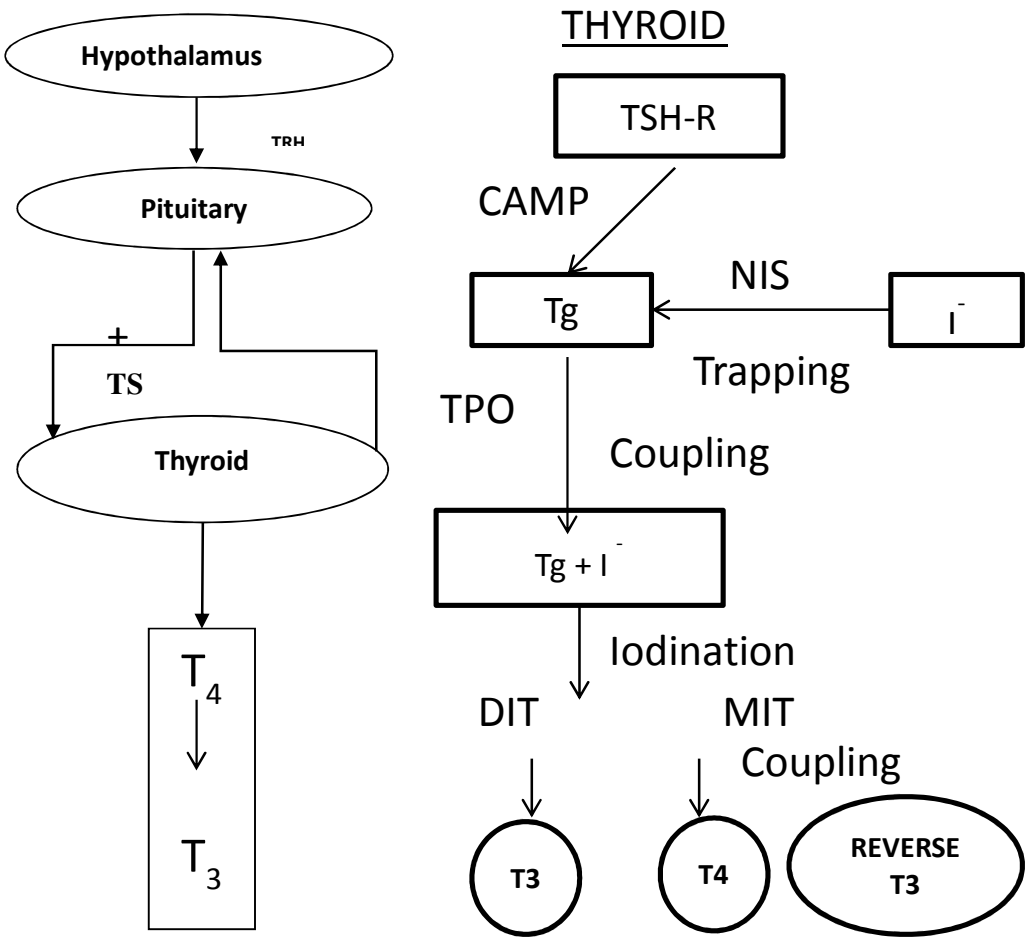
There was no difference between stimulation of 1 or 2 mA and no difference in stimulation characteristics of men and women. Lower thyroartyenoid amplitude with external branch stimulation is consistent with canine data.Two recent studies have demonstrated positive voice outcomes with neural monitoring of external branch. In a small study of thyroidectomy under local anaesthesia, external branch monitoring resulted in improved visualization of the nerve and improvement in voice according to post operative surveys(43,44,45).

PHYSIOLOGY OF THYROID

Thyroid hormone synthesis begins in the fetus at 11 weeks of gestation. TSH is the important stimulator of thyroid gland and also a marker for thyroid dysfunction. TSH works by negative endocrine feedback system. TSH production occurs by pulsatile manner and it reaches peak value at night. Thyroid hormone acts by its nuclear receptor.

Ultimobronchial bodies gives to thyroid medullary C cells that produce calcitonin. C cells aggregated at upper 2/3 lower 1/3 of thyroid gland.

THYROID HORMONE SYNTHESIS



Spectrum of thyroid disease

Functional abnormality of the thyroid is grossly classified in to Hypo thyroid and hyper thyroid.

In both conditions medical management in the mainstay of treatment

Inflammatory conditions of the thyroid are called as thyroiditis

a. Acute thyroiditis is due to Bacterial infection and fungal infection, radiation thyroiditis and drug induced (amiodarone).
b. Sub acute thyroiditis includes viral, that is otherwise called as granulomatous thyroiditis, silent thyroiditis, TB thyroiditis.
c. Chronic thyroiditis includes Hashimoto's, Reidel's Thyroiditis

Goiter and Nodular thyroid Disease are common clinical thyroid problems.

Pathology of nodule formation

Persistent growth stimulation can cause diffuse hyperplasia which is reversible. Then fluctuating stimulation leads to areas of active and inactive lobules. The active lobules are more vascular leading to haemorrhage into follicle will cause necrosis leaving surrounding active follicles. Necrotic lobules unite to form nodules filled colloid or mass of inactive follicles. This process continues will cause nodule formation.

1. Diffuse non toxic simple goiter (colloid goiter)
   - cause : iodine deficiency (Endemic goiter)
   - treatment is medical
2. Single solitary nodular goiter
3. Multi nodular goiter

Complications

a. Toxicity
b. Malignancy
c. Retrosternal extension
d. Pressure effects
e. calcification

4. Thyroid malignancy
   - differentiated thyroid cancer includes papillary and follicular variety and Hurthle cell carcinoma.
   - Undifferentiated thyroid cancer includes anaplastic and medullary carcinoma of thyroid.

Clinical features of thyroid disorders

In thyroid disorders, age of the patient should be significantly considered. Simple goiter is observed in pubertal girls. MNG, SNG and colloid goiters are seen in females of 20s and 30s. Papillary carcinoma is seen in young girls and follicular carcinoma seen in middle aged women. Anaplastic carcinoma is the disease of old age. Primary toxic goiter is seen in young females whereas Hashimoto's thyroiditis is seen in middle aged middle aged women.

Areas where there is iodine deficiency there will be the occurrence of endemic goiter. Most of the thyroid disorders present with swelling infront of the neck. The inflammatory conditions of thyroid are painful. The malignant conditions of thyroid gland are initially painless to start with and then later on become painful.

Pressure effects

Thyroid swelling may compress on the trachea to produce dyspnoea or it can compress on oesophagus to produce dysphagia. Hoarseness or change in voice is commonly due to infiltration of the recurrent laryngeal nerve by the malignant thyroid.

Symptoms of primary hyperthyroidism

The most notorious symptom of primary thyrotoxicosis is loss of weight inspite of good appetite. Cold preference, heat intolerance and excessive sweating are the next prominent symptoms. Neurological symptoms such as nervous excitability, irritability, insomnia, tremors in hand, muscle weakness are more pronounced in primary thyrotoxicosis. Eye signs such as exopthalmous, staring or protruding eyes, difficulty in

closing the eyes, chemosis are usually associated with this condition. Some females have amenorrhea.

Symptoms of secondary thyrotoxicosis

When a longstanding colloid goitre, SNG or MNG shows manifestations of thyrotoxicosis this condition is called as secondary thyrotoxicosis. The brunt of attack falls more on cardiovascular system than nervous system. Palpitations, ectopic beat, cardiac arrhythmia, dyspnoea on exertion and chest pain are prominent symptoms. Even patient may have congestive cardiac failure at later stages. Ophthalmic symptoms and nervous symptoms are mild or absent.

Symptoms of hypothyroidism

Increase of weight, inspite of poor appetite is the significant symptom. Cold intolerance, preference for warmth, dry skin puffiness of face, pouting lips, dull expressions, constipation , muscle fatigue, lethargy, failing memory, loss of hair,hoarseness of voice, and oligomenorrhoea are the other symptoms of hypothyroidism.

Regarding past history patient should be questioned about anti thyroid drugs, any previous history of neck swelling, neck surgery. Patient should be asked about the intake of goitrogens such as cabbage, kale and rape. And family history of any thyroid disorders should also be sought for.

Physical examination

1. General survey

2. Build and state of nutrition

In thyrotoxicosis the patient is usually thin and underweight. The patient sweats a lot with wasting of muscles and in hypothyroidism the patient is obese and overweight. In case of carcinoma of thyroid there will be signs of anaemia and cachexia.

3. Facies

In thyrotoxicosis one can see the facial expression of excitement, tension, nervousness or agitation with or without variable degree of exophthalmos. In hypothyroidism one can see puffy face without any expression (mask - like face).

4.Mental state and intelligence - Hypothyroid patients are naturally dull with low intelligence. This is more obvious in cretins.

Not only the pulse rate becomes rapid, but it becomes irregular in thyrotoxicosis. Irregularity is more of a feature of secondary thyrotoxicosis. Particularly sleeping pulse rate is a very useful index to determine the degree of thyrotoxicosis. In case of mild thyrotoxicosis, it should be below 90, where as in case of moderate or serve thyrotoxicosis it should be between 90 to 110 and above 110 respectively. In hypothyroidism the pulse becomes slow.

Skin

The skin is most particularly the hands in case of primary thyrotoxicosis. The clinician while feeling for the pulse should take the opportunity to touch the hand as well. Hot and moist palm is came across in primary thyrotoxicosis. Skin is dry and inelastic in myxoedema.

Local examination

Inspection

Normal thyroid gland is not obvious on inspection. It can be seen only when the thyroid gland is swollen. To render inspection easier one

can follow Pizzillo's method in which the hands of the patient are placed behind the head and the patient is asked to push her head backwards against her clasped hands on the back of his/her head. The thyroid swelling may be uniform or isolated nodules of different sizes. A thyroid swelling moves upwards on deglutition. This is due to the fact that the thyroid gland is fixed to the larynx. Such movement of the thyroid becomes greatly limited when it is fixed by inflammation or malignant infiltration.

In retrosternal goiter patient should be asked to raise both the arms of the patient over his head until they touch the ears. This position is to be maintained for sometime. Distress and congestion of face become evident in retrosternal goiter due to obstruction at the level of thoracic inlet of the great veins.

A thyroglossal cyst also moves upwards on deglutition. But the pathognomonic feature is that it moves upwards with protrusion of the tongue.

Palpation

The thyroid gland should always be palpated with the patient's neck slightly flexed. The gland may be palpated from behind and from

the front. Careful assessment of the margins of the thyroid gland is important, particularly the lower margin.

Palpation of each lobe is best carried out by Lahey's method. The examiner stands in front of the patient. To palpate the left lobe properly, the thyroid gland is pushed to the left from the right side by the left hand of the examiner. This makes the left lobe more prominent so that the examiner can palpate it thoroughly with his right hand.

Slight enlargement of the thyroid gland or presence of nodules in its substance can be appreciated by simply placing the thumb on the thyroid gland while the patient swallows. (Crile's method)

Following points should be noted during palpation:

- the whole thyroid gland enlargement is whole or not.
- When a swelling is localized
- Mobility

To rule out the possibility of the retrosternal extension of the gland, getting below the thyroid examination should be done.

Pressure effect

Pressure may be on the trachea or larynx, which may lead to stridor and later on dyspnoea. Pressure may be on the oesophagus which may

lead to dysphagia. Pressure may be on the recurrent laryngeal nerve, which may lead to hoarseness of voice. If pressure on trachea is suspected, slight push on the lateral lobes will produce stridor(Kocher's test). This test, if positive, indicates an obstructed trachea.

Narrowing of the trachea i.e. scabbard trachea becomes quite obvious in skiagram. A malignant thyroid may engulf the carotid sheath completely and so the pulsation of the artery could not be made out. Sympathetic trunk may also be affected by thyroid swelling. This will lead to Horner's syndrome.

- Enophthalmos
- Pseudoptosis
- Miosis
- Anhidrosis
- Palpation of cervical lymph nodes

This is extremely important particularly in malignancy of thyroid. Papillary carcinoma of thyroid is notorious for early lymphatic metastasis when the primary tumour remains quite small.

Percussion

This is done to rule out the retro sternal extension of the thyroid.percussion is made over the manubrium sterni.

Auscultation

A systolic bruit can be heard over the enlarged thyroid gland in case of primary toxic goiter.

General examination

Eye signs

1. **Lid retraction** – This sign is caused by over-activity of the involuntary part of the levator palpebrae superioris muscle. When the upper eye lid is higher than normal and the lower eyelid is in its normal position this condition is called lid retraction.
2. **Exophthalmos** – when eyeball is pushed forwards due to increase in fat or oedema or cellular infiltration in the retro-orbital space the eyelid are retracted and sclera becomes visible below the lower edge of the iris first followed by above the upper edge of the iris.

i. **Von Graefe's sign** – The upper eyelid lags behind the eyeball as the patient is asked to look downwards.

ii. **Joffroy's sign** – Absence of wrinkling on the forehead when the patient looks upwards with the face inclined downwards.

iii. **Stellwag's sign** – This is staring look and infrequent blinking of eyes with widening of palpebral fissure.

iv. **Moebius's sign** – This means inability or failure to converge the eyeballs.

v. **Dalrympte's sign** – This means the upper sclera is visible due to retraction of upper eyelid.

3. **Ophthalmoplegia** – there may be weakness of the ocular muscles due to oedema and cellular infiltration of these muscles.

4. **Chemosis** is caused by obstruction of the venous and lymphatic drainage of the conjunctiva by the increased retro-orbital pressure.

Tachycardia or increased pulse rate without rise of temperature is constantly present in primary toxic goiter. Sleeping pulse rate is more confirmatory in thyrotoxicosis.

Tremor of the hands is almost always present in a primary thyrotoxic case.

Moist skin particularly of the hands and feet are quite common in primary thyrotoxic cases.

Thyroid bruit is also quite characteristic in Graves' disease (primary thyrotoxic). This is due to increased vascularity of the gland.

Secondary thyrotoxicosis

Here atrial fibrillation is quite common. Signs of cardiac failure such as oedema of the ankles, orthopnoea, dyspnoea while walking up the stairs may be observed. Exophthalmos and tremor are usually absent.

INVESTIGATIONS OF THYROID DISORDERS(46,47,48,49,50,51,52)

The various investigations for diagnosing thyroid diseases can be divided as follows

1.Tests of thyroid function

2.Thyroid autoantibodies

3.Thyroid imaging

4.Cytology

Tests of Thyroid function:

The improved sensitivity and specificity of TSH assays have greatly improved laboratory measurement of thyroid function. A rational approach to thyroid testing is to determine if TSH levels are increased,

decreased or normal. A normal TSH level excludes a primary abnormality of thyroid function in rare occasions. Immune radiometric assays one of the tools used to determine the thyroid function and they are very sensitive. The widespread use of TSH IRMA has rendered the TRH stimulation test outdated. The finding of an atypical TSH level should be followed by measurement of circulating thyroid hormone levels to prove the diagnosis of hyperthyroidism (suppressed TSH) or hypothyroidism (elevated TSH).T3 and T4 are highly protein bound and numerous factors can manipulate protein binding. It is useful to measure free or unbound levels of hormone.

For most patients the T4 level which is unbound is sufficient to confirm the state of thyrotoxicosis but elevated T3 levels(T3 thyrotoxicosis) seen in 2% of individuals .Thus unbound T3 levels be required to be measured in those with suppressed TSH levels with normal unbound T4 levels.

In thyroid cancer patients, Serum thyroglobulin levels are used in the follow up. After total thyroidectomy and radio-ablation it should be undetectable. Levels greater than 1-2ng/ml suggest inadequate ablation or recurrent cancer.

Thyroid auto-antibodies

Autoimmune thyroid disease is detected most easily by detecting circulating antibodies against thyroid peroxidase (TPO) and Thyroglobulin(Tg).Almost all patients with autoimmune hypothyroidism and upto 80% of those with Graves Disease have TPO antibodies at high levels.

Thyroid Imaging:

1. Chest and Thoracic Inlet Radiography

Simple Radiographs of the chest and neck will demonstrate if there is any retrosternal extension of goiter or significant tracheal compression. Pulmonary metastasis might also be detectable.

2. Radiography of Neck

Plain radiographs of neck in both antero-posterior and lateral views are taken to look for-

- Position of Trachea
- Pre tracheal soft tissue shadow
- Evidence of retrosternal extension
- Any compression of trachea
- Calcification of soft tissue

- Status of cervical spine

2. Indirect Laryngoscopy(IDL)

This is done preoperatively to look for vocal cord movements. Some patients will have asymptomatic paralysis of recurrent laryngeal nerves. So this examination is very important from medico-legal aspect.

4 Ultrasound Scanning [USG]

Now USG is considered as extension of the clinical examination. It is one of the basic investigation for thyroid swelling.

a. Differentiate benign from malignant nodule
b. The ultrasonography can demonstrate sub clinical nodularity and identify deep non-palpable thyroid nodules.
c. Size of the nodule can be measured
d. It can also differentiate solid from cystic swellings
e. Sono guided FNAC can be done
f. Identify cervical lymph nodes
g. Identify multicentricity.

Features of Benign Lesion in USG

The following features are indicative of a benign nature

1. Hyper echoic nodule

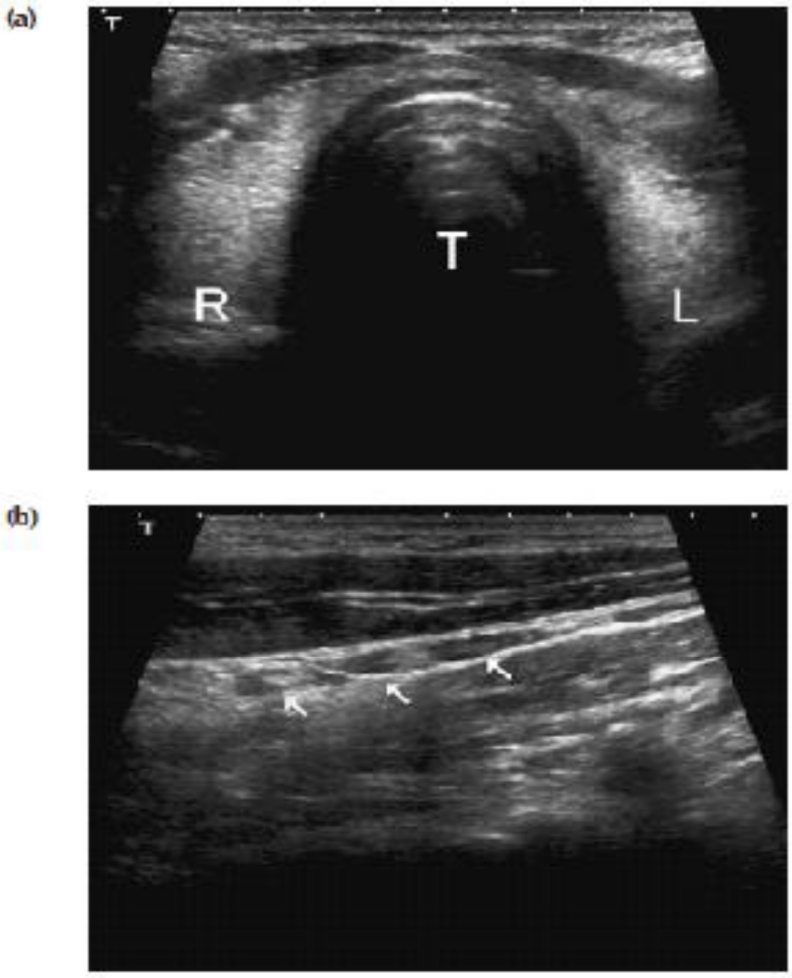
2. Significant cystic component
3. Peripheral egg shell like calcification
4. A sonolucent rim (halo) around the nodule
5. Well – defined nodule margin

Feature of Malignant Lesion in USG

The following features should arouse a strong suspicion of malignancy

1. Hypo echoic
2. Cystic component need not be there
3. Micro calcifications
4. No halo
5. Poorly defined margin
6. Taller than wide lesion
7. Increased central vascularity

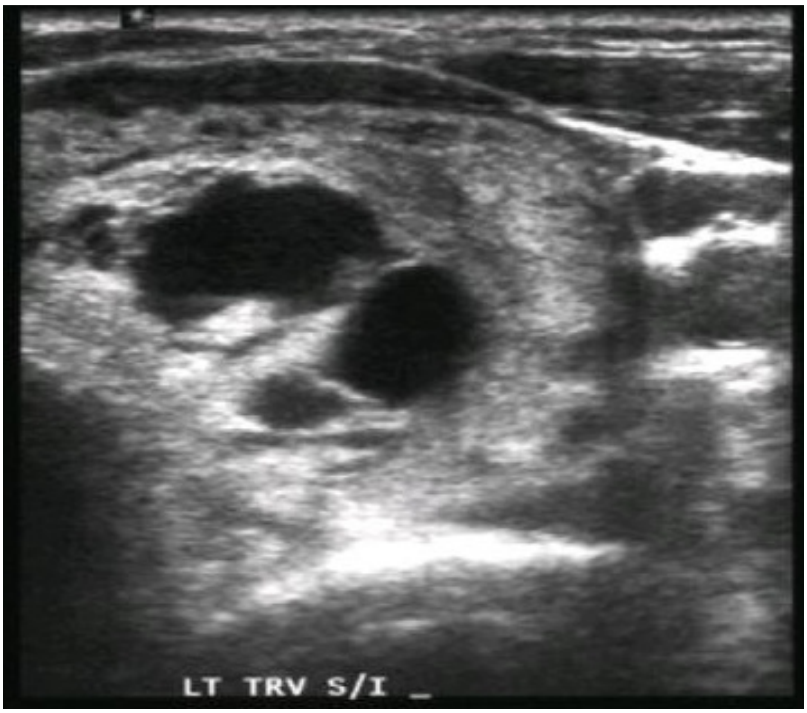
USG Showing Normal Thyroid



USG Guided placement of the needle during a thyroid FNAC biopsy

Ultrasound uses a high frequency probe in the 7.5-12MHz range. Ultrasound devices have become portable enough to allow use in the clinic and operating room.

USG Showing Solid and cystic Components



5.Radioisotope Scanning

Radionuclide imaging serves to confirm the presence of the nodule within the thyroid, identifies the functional characteristics of the nodule.

The only absolute indication in thyrotoxicosis for isotope scanning is for the diagnosis **Autonomous Toxic Nodules**

Toxicity with nodularity is an indication. It can identify hypo functioning nodules (cold). Cold nodule in Graves' is likely to be malignant.

It is the only method by which one can definitely differentiate primary, secondary and toxic nodules.

Isotope scan can also differentiate hyper thyroidism from toxicosis due to other causes. (to differentiate hyperthyroid thyrotoxicosis from non- hyperthyroid thyrotoxicosis). The radioactive iodine uptake (RAIU) is increased in hyperthyroidism whereas toxicosis because of extrathyroidal causes the RAIU is decreased (eg. thyroiditis)

Other indications for isotope scan are:

1. To identify ectopic thyroid tissue.
2. To identify recurrence and metastases in thyroid carcinoma.
3. ^{99m}Tc is the isotope of choice for diagnostic purposes. It is cheap and the radiation is less than radioiodine. Twenty minutes after intravenous injection of ^{99m}Tc, scanning is done over the thyroid.
4. If radioactive iodine is used 123I is the isotope of choice for diagnostic purposes.
5. Carcinoma concentrates technetium and therefore a hot nodule need not necessarily be benign.

6. A nodule which is warm on technetium scanning and cold on radioiodine scanning is called discordant scan. This is suggestive of malignancy.

Surgery is generally required to provide a definitive diagnosis, although needle biopsies have been used in some major medical centers.

Another indication for radioisotope thyroid scanning was in the treatment of thyroglossal cyst before excision to rule out the possibility of an ectopic thyroid. Pertechnetate ion is selectively concentrated in the thyroid gland, salivary glands and stomach. In normal subjects, up to 2 % of the radioactivity from intravenously injected pertechnetate-99m is accumulated by the ion-concentrating mechanism of the thyroid at 1 hr. Thirty min after administering 1 me of pertechnetate-99m intravenously, good scans of the thyroid are obtainable. Iodine 123 and Iodine 131 scintigraphy is also used to evaluate the functional status of the thyroid gland. Both are trapped by active follicles and organified. ^{123}I has a shorter half-life (12-13hrs) and gives a quicker image and low dose of radiation (30 mrad). It is a good choice for suspecting lingual thyroid or substernal goitre.

^{131}I has longer half-life (8 days) and emits higher levels of radiation. It is the screening modality of choice for evaluation of distant metastasis. It is generally accepted that glucose metabolism is increased,

particularly in poorly differentiated carcinomas. FDG PET is therefore thought to be more effective for the detection of undifferentiated thyroid carcinoma, with a low sensitivity of ^{131}I whole-body scan.

6. CT and MRI

CT and MRI do not add significantly to the work up of uncomplicated thyroid nodules. Either modality may be helpful in the evaluation of local extension of advanced thyroid carcinoma. It is also appropriate foe the evaluation of suspicious (or biopsy proven cancer) with palpable cervical lymph nodes. Additionally either can be used in the follow up of recurrent disease. It can also be used for large goiter with tracheal deviation to rule out substernal extension. Consideration must be given to the use of IV contrast foe CT evaluation of a possible cancer. The iodine may interfere with postoperative plans for ^{131}I scanning.

7. Fine Needle Aspiration Cytology (FNAC):

Because of the risk of neoplasia, the single most important investigation of choice is Fine Needle Aspiration Cytology (FNAC).An adequate smear should have at least six clusters of cells each containing about 20 cells.

The overall diagnostic accuracy is about 95%

The diagnostic sensitivity of 83% and specificity of 92%

FNAC reports

a. Benign – adundant colloid and typical follicular cells
b. Malignant
c. Indeterminate – little colloid and many follicular cells or Hurthle cells (Follicular neoplasm suspicious)
d. Inadequate – Cystic lesions, degenerating adenomas.

Classification

Thy 1 – Non – diagnostic

Thy 2 – Non – neoplastic

Thy 3 – Follicular

Thy 4 – Suspicious of malignancy

Thy 5 – Malignant

In future, FNAC differentiation may be possible by the following techniques:

a. Ploidy study of the DNA material: polyploidy for benign and aneuploidy for carcinoma
b. Benign tumors are monoclonal and malignant tumors are polyclonal (monoclonal antibody MOAB 47)

c. Magnetic resonance spectroscopy

d. Thyroimmunoperoxidase estimation

Definite diagnosis by FNAC

1. Colloid nodule
2. Thyroiditis
3. Papillary carcinoma
4. Medullary carcinoma
5. Anaplastic carcinoma
6. Lymphoma

For aspiration, the neck was extended, supported by a small pillow and a 10 ml syringe with a 23 gauge needle was used. Two or three separate aspirations were made with several passes through the lesion. The aspirates were air-dried on microscope slides and stained with May-Greenwald- Giemsa stain.

FNAC can often suggest a precise diagnosis of a thyroid lesion but, from the point of view of management, the important issue is whether the findings suggest cancer. The possibility of the false negative has always to be borne in mind for it has averaged about 5-14% in most studies. If the tumour contains much colloid, which may occasionally happen in

follicular cancers, then on cytological evidence alone it may be regarded as a colloid nodule.

Its discriminating value is relatively high compared with the scanning methods and it is much less consuming of time and expensive equipment. Moreover if the nodule proves to be a simple cyst, the diagnostic procedure can be combined with that of treatment, namely cyst aspiration, and, if necessary, sclerosant injection which is usually curative.

Medical management of thyroid disorder

Hypothyroidism – replacement dose 100 microgram

(TSH Suppression dose 300 microgram

Hyperthyroidism -

1. Propylthiouracil 100 to 200 mg TDS.

Inhibitis thyroid peroxidase, and peripheral conversion.

Can be given in the pregnancy.

2. Carbimazole 10 to 20 mg thrice daily.

Active component methimazole.

Most effective drug.

3. Propranalol 20 to 40 mg

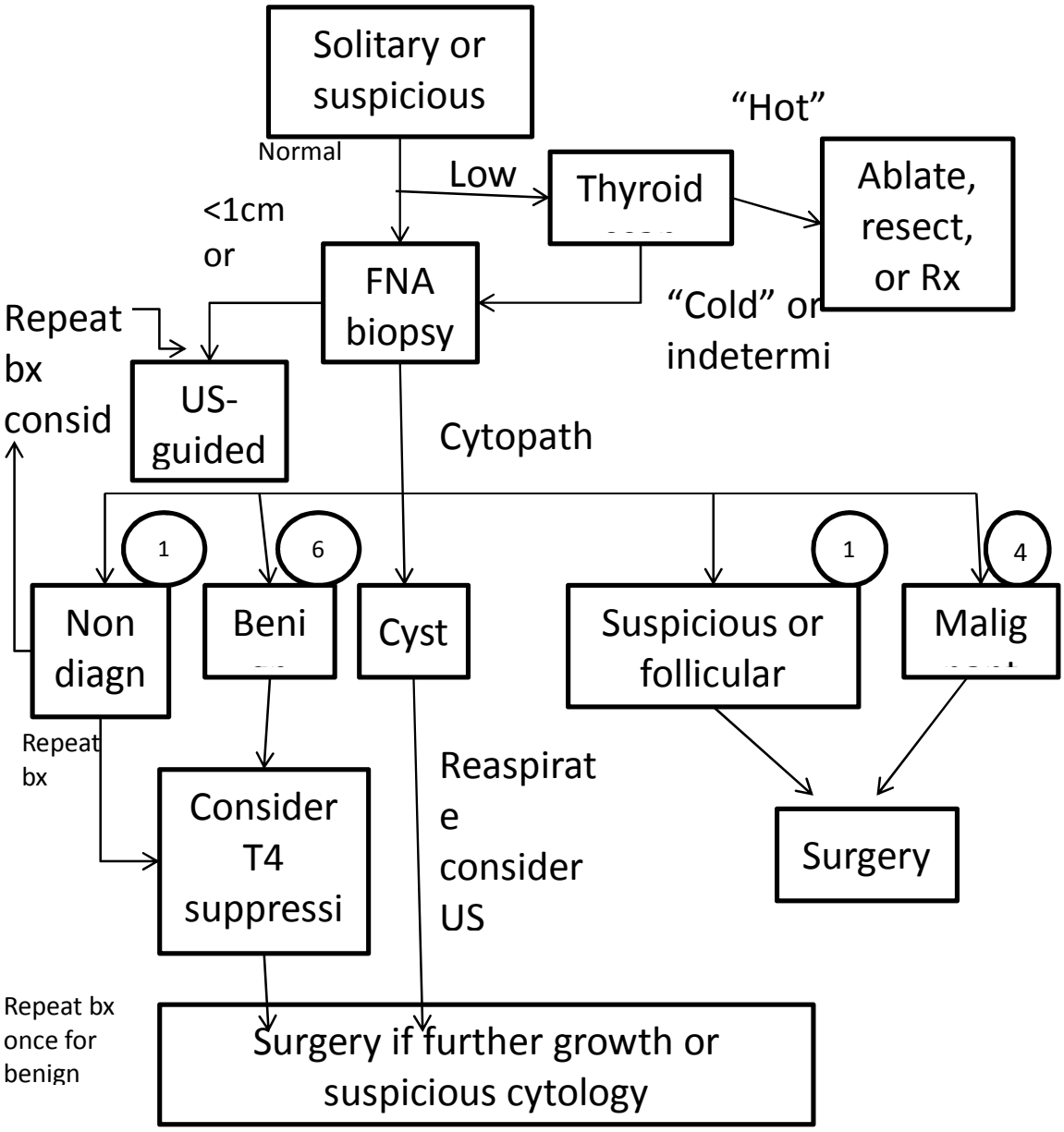
   Inhibit peripheral conversion

3. RAI

Used in ablation of remnant thyroid tissue.

Contra indicated in pregnancy, younger individuals.

Approach to PT with Thyroid Nodule



OPERATIVE SURGERY OF THYROID GLAND

PREOPERATIVE PREPARATION

Informed consent

As with any operation, the surgeon should have a thorough discussion with the patient about the indications, alternate treatment

options, and potential complications of thyroidectomy. Complications for thyroid lobectomy include injury to the recurrent laryngeal nerve, resulting in a hoarse voice, and external branch of the superior laryngeal nerve, leading to an inability to reach the high octaves when singing.

The parathyroid glands could also be inadvertently injured. This does not pose a problem with a thyroid lobectomy (since the contralateral two parathyroids would be sufficient), but increases the risk of hypoparathyroidism should future thyroid or parathyroid surgery be required since the remaining parathyroid glands would be at risk.

Postoperative bleeding and subsequent hematoma formation is a potential life threatening complication that must be carefully monitored during the postoperative period. Wound infections are uncommon. The most common wound complication is seroma formation that usually resolves spontaneously.

Patients should be aware that after total or near-total thyroidectomy they will be required to take lifelong replacement of thyroid hormone. When patients are stratified into three groups based on their preoperative TSH measurement (<1.5, 1.51 to 2.5, and >2.51 μIU/mL), the rate of hypothyroidism after thyroid lobectomy increases signifcantly at each level .Thus, preoperative TSH levels can be used to predict the likelihood of postoperative hypothyroidism.

Preoperative testing:

In all patients undergoing thyroid surgery, to check the preoperative calcium and parathyroid hormone level to rule out hyperparathyroidism, and to obtain a baseline value for comparison. In patients who are diagnosed with hyperparathyroidism, to perform parathyroidectomy at the time of thyroidectomy. If the patient has a hoarse voice preoperatively or if has had a previous operation that placed the vagus or recurrent laryngeal nerve at risk, he or she should have direct or indirect laryngoscopy preoperatively to assess the status of the recurrent laryngeal nerves. A paralyzed nerve may alter operative plans and should definitely be discussed when obtaining informed consent. A procedure planned on the side contra lateral to a nerve injury risks bilateral nerve injury and the need for tracheostomy.

Perioperative considerations:

Patients should urinate immediately preoperatively so that there is no need for a Foley catheter. As thyroidectomy is classified as a “clean” operative procedure, prophylactic antibiotics are not required unless the patient has a special medical condition warranting their administration. Compression stockings and sequential compression devices are used selectively for deep vein thrombosis (DVT) prophylaxis.

SURGICAL TECHNIQUE:

Definition of terms:(53)

- Lobectomy is defined as the complete removal of one lobe without disturbing the capsule and isthmus preservation.
- Hemithyroidectomy means that removal of one lobe with its capsule and isthmus.
- Total thyroidectomy means removal of Rt and Lt lobe with its isthmus
- Subtotal thyroidectomy is defined as removing thyroid gland leaving 4 gram of tissue on either side of the thyroid gland.
- Near-total thyroidectomy is defined as removing thyroid gland leaving behind 2 gram of thyroid tissue on the whole.

General Principles:

Following principles apply to all thyroid surgeries.

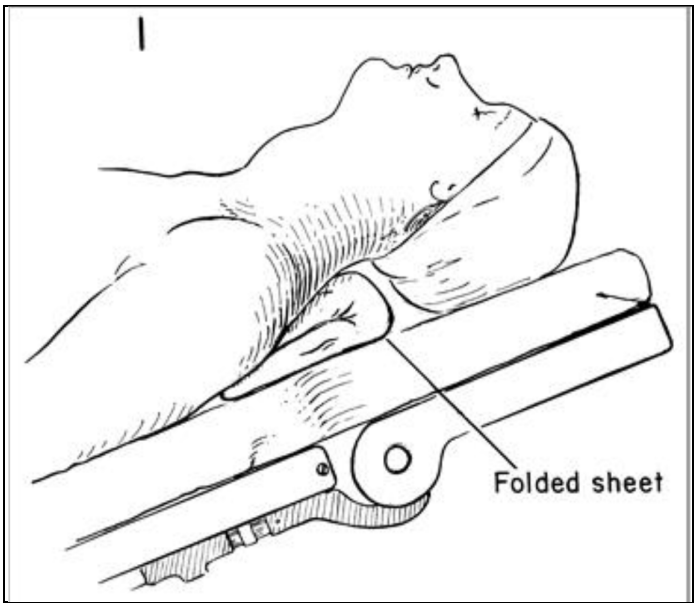
- Good exposure of the gland.
- Proper identification of anatomic structures.
- Bleeding to be kept to minimum.
- Diathermy (even bi-polar) to be avoided in the area of laryngeal nerves.

Technical aspects

Thyroid lobectomy-1

Following the initiation of induction of general anaesthesia, the patient remains in the supine position, arms straight and tucked at their sides, and generous padding is placed at the elbows to prevent nerve injury. The patient's neck is midline and extended. This neck extension is performed with extreme caution and with the assistance of the anaesthesia team to ensure that the endotracheal tube is secured and that the cervical spine is not overextended or suspended.

Preoperative assessment should include asking the patient to fully extend his or her neck, so that the person positioning the patient knows the level of natural neck extension.



There is a slight risk of injury to spinal cord due to hyperextension of the neck and prolonged and increased post operative pain .The head and the body should be in a perfect alignment to prevent incorrect placement of incision the cervical region. The isthmus of the thyroid overlies the second and third tracheal rings just caudal to the cricoid cartilage appropriate positioning of neck and shoulder. A deflated IV bag is placed under the patient's shoulders to extend the neck and support the shoulders and lower cervical spine. The bag which is deflated is then inflated to produce neck extension to an appropriate amount. The head ring will give good support to head . A headlight facilitates exposure and lightning through the limited incisions. During the operation, the table is placed in a Trendelenburg position to decrease the cervical venous pressure.

The location of the cricoid cartilage is made out by palpation. The incision is made over the skin crease that should be approximately 2cm above the suprasternal notch and about 1 cm below the cricoid cartilage. The incision should be oriented along the lines of Langer. There are more chances of prominent scarring if the incision crosses the normal skin lines. Since the skin crease has the least amount of tension, it is advisable to make incision over the neck crease whenever possible. An incision

which is not along the line of skin crease will result in scar formation, and then dissection of the superior pole is very difficult, and perhaps the thyroid may be missed entirely. Removal of lymph nodes will be difficult in indicated persons if the incision is placed too high and that too will be cosmetically unpleasant.

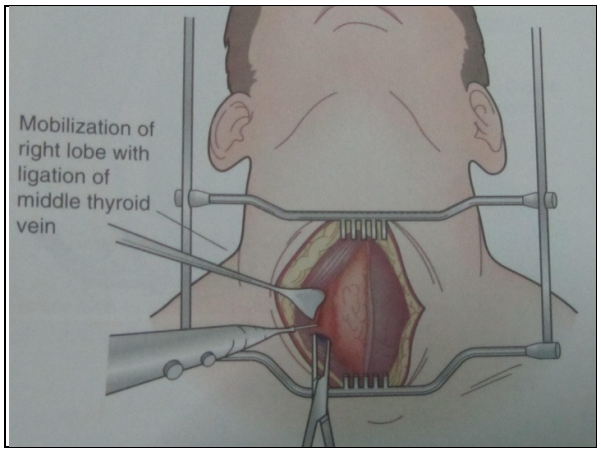
The incision over the skin must be made with a clean sweep of the scalpel, that should divide skin and subcutaneous tissue simultaneously. electro cautery can be used to obtain complete hemostasis. The incision should be deepened till the plane of areolar tissue is reached which lies beneath the platysmal layer where there is an avascular plane. Once the subplatysmal plane is reached, flaps are raised superiorly and inferiorly.

Raising the skin flap with the help of two Allis foreceps may keep the flap under tension. The vertical traction of the flap with the allis foreceps and the counter traction given by the surgeon will expose the bloodless plane.it is ideal to proceed the dissection in the avascular plane between the muscle fibres of platysma and jugular vein. The combination of blunt and sharp dissection can be utilized in this plane alternatively. For raising the skin flap electro cautery is acceptable.

The flap raised above upto thyroid cartilage and below up to suprasternal notch. Don’t go beyond the suprasternal notch due to inadverdent injury to communicating anterior jugular veins.

The retracted skin should be protected from button hole injury due to diathermy and to avoid the anterior jugular veins, which should remain on the anterior surface of the sternothyroid muscle. There is symmetrical flanking of anterior jugular veins in the midline raphe of the neck.

Inadverdent injury to the jugular veins may lead to air embolus and active bleeding.so care must be employed not to injure the jugular veins. The skin flaps are held apart with a help of suture or by self retaining Sippel or spring retractor.



The investing layer of deep fascia now exposed. The deep fascia now opened vertically by scissors or with electrocautery superiorly upto thyroid notch and interiorly upto suprasternal notch. The strap muscles are separated away from the mid line by using blend dissection or with cautery. Now the thyroid with intact capsule hold by Babcocks forceps and the strap muscles are dissected away. When need to transect strap

muscles the transaction done at superior level to prevent injury to Ansa cervicalis which supplies the strap muscles

Care must be taken not to injure the veins as there may be veins crossing the superior and inferior aspects of the midline which may cause bleeding.. The ipsilateral strap muscles are then grasped with a Babcock clamp and gently dissected of the thyroid capsule with electro cautery and blunt dissection with a Kitner or a teardrop suction device. The avascular plane between the thyroid gland and the avascular plane can be dissected bluntly until the internal jugular vein is identified. Progression to the correct cleavage plane will permit lateral mobilization of the sternohyoid and sternothyroid muscles. This is only performed on the side ipsilateral to the lobe to be excised.

Raised Subplatysmal flap

Once the thyroid lobe is exposed, the initial step is to divide the superior pole vessels to mobilize the upper lobe. The superior pole vessels are then dissected free laterally. Blunt dissection is employed to

sweep the areolar tissue and remaining strap muscle fibers from the lateral superior thyroid pole. This pole is then separated from the cricothyroid muscle .Extreme care is taken to keep all medial dissection close to the thyroid lobe so as to not place the external branch of the superior laryngeal nerve at risk. This nerve can lie on the lateral surface of the cricothyroid muscle, in close proximity to the superior pole blood vessels.

As the superior thyroid lobe is mobilized, the superior parathyroid gland which underlies should be taken care from injury. After mobilization and rotation of the upper lobe medially, the remaining thyroid lobe is then mobilized from lateral to medial. To achieve exposure, the gland is retracted anteriorly and medially with the surgeon's index finger and the strap muscles are held laterally with a retractor. Blunt dissection clears areolar tissue from the lateral aspect of the thyroid lobe. The middle thyroid vein is divided between clamps and tied with 2-0 silk sutures.

This dissection permits full medial rotation of the thyroid lobe. With the lateral and superior aspect of the thyroid dissected free, the thyroid can now be mobilized medially and anteriorly, out of the operative wound. The thyroid lobe is then retracted in this antero-medial position for the remainder of the procedure, and is best held under slight

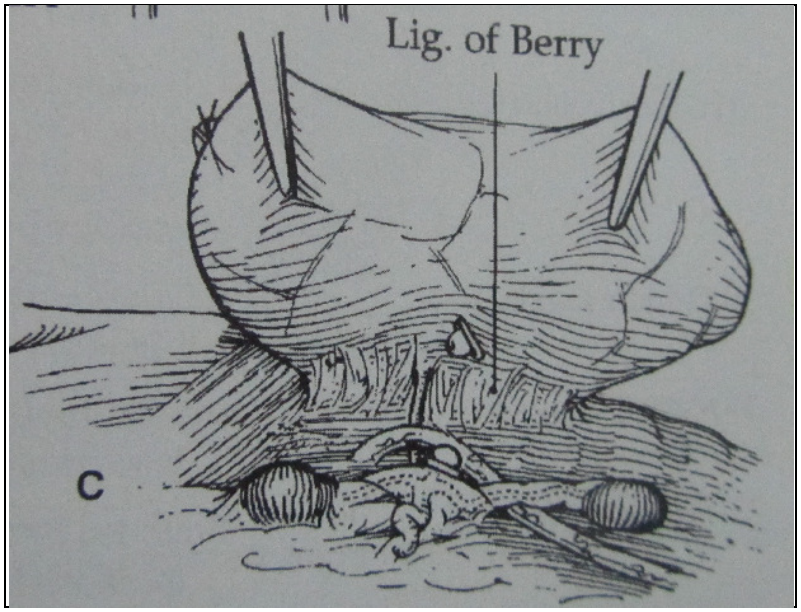
tension with the surgeon's index finger covered with a sponge. With this manoeuvre, the recurrent laryngeal nerve can now be identified, as can the parathyroid glands.

About 85% of the parathyroid glands are found within 1 cm of where the recurrent laryngeal nerve crosses the inferior thyroid artery, with the superior parathyroid gland located posterior to the nerve and the inferior gland located anterior to the nerve .The superior parathyroid gland is more likely to be in direct contact with the thyroid capsule posteriorly (near the tubercle of Zuckerkandl at the level of the cricoid cartilage), and can be identified once the thyroid is retracted medially. After careful dissection to create a plane between the thyroid capsule and superior parathyroid gland, blunt dissection with a Kitner can push the parathyroid back on a broad pedicle, safely away from the operative field. Surgical clips can mark the parathyroid glands for future identification and provide hemostasis with minimal manipulation of the blood supply to the gland.

The right or left recurrent laryngeal nerve should be always identified during the lobectomy. It should run directly medial to the superior parathyroid, and can be visualized after pushing the superior parathyroid gland laterally. The right recurrent nerve travels laterally in the lower neck and then travels obliquely toward the midline at an angle

approximately 30 degrees to the trachea esophageal groove. During this course, it can pass behind, between, or anterior to the main branches of the inferior thyroid artery.

The left nerve, on the other hand, travels in the trachea esophageal groove for its entire cervical course. The recurrent nerves can be identified in the inferior aspect of the operative field if there is associated inflammation or scarring closer to the thyroid. In order to protect the nerves, only tissue that is transparent and/or definitively identified to be vascular or lymphatic should be divided. After identification of the recurrent nerve along its entire course, the lower parathyroid is located.



The inferior pole vessels are the blood supply to the inferior parathyroid glands and most superior parathyroid glands, which is why only the terminal branches directly entering the thyroid should not be divided. Branches of the inferior thyroid artery are divided as close to the thyroid gland as possible to avoid devascularizing the parathyroids.

The final dissection of the anterolateral aspect of the trachea, through the remainder of the ligament of Berry, should be performed carefully since this is the area where the nerve is at greatest risk of injury. Once on the anterior aspect of the trachea, this is an avascular plane.

The thyroid isthmus is mobilized of the anterior trachea with electro cautery to the intersection with the contra lateral lobe. The thyroid isthmus is then divided.

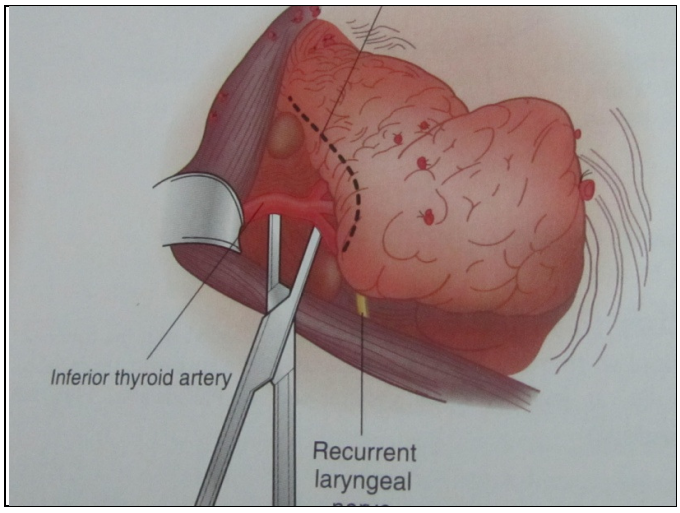
With the specimen excised, it is re-examined to ensure that no parathyroid tissue has been inadvertently removed. If a normal parathyroid gland is identified on the excised thyroid specimen, it should be auto-transplanted immediately .The operative field is irrigated and hemostasis ensured. Surgicel is useful when there is minimal bleeding immediately adjacent to the recurrent laryngeal nerve, which is often just as the nerve enters the larynx posterior to the cricothyroid muscle. The strap muscles are then re approximated in the midline with a running 2-0 vicryl suture. The platysma is re approximated with a running 3-0 vicryl

suture. Drains are inserted although in some centers they are not used. Skin closure is with a 5-0 Prolene suture.

Subtotal thyroidectomy

In a traditional subtotal thyroidectomy, 2 to 3 g of thyroid tissue is left bilaterally. This is no longer recommended, because recurrent disease can occur bilaterally and reoperation would place both recurrent laryngeal nerves and all functioning parathyroid glands at risk.

Sub Total Thyroidectomy



Instead, a Hartley–Dunhill subtotal thyroidectomy is now recommended if residual thyroid tissue is left in situ. This involves a total lobectomy and isthmusectomy on the most diseased side and a subtotal resection (leaving approximately 4 g) on the contra lateral side. Subtotal

thyroidectomy should not be performed for patients with malignant disease as thyroid tissue left in situ on the side of the primary tumor is at risk for recurrent disease, higher doses of radioactive iodine (RAI) are required after subtotal thyroidectomy, and thyroglobulin assays are less sensitive for predicting tumor recurrence.

When a subtotal thyroidectomy is planned, a thyroid lobectomy should be performed on the most diseased lobe. On the side of the subtotal resection, the upper pole vessels and the inferior pole vessels are mobilized and divided to mobilize the thyroid gland out of wound middle thyroid vein is divided. The recurrent nerve is identified. However, branches of the inferior thyroid artery are not ligated. The postero-lateral resection margin through the thyroid is selected so that an appropriate volume of thyroid tissue is left in situ, while keeping the dissection plane safely anterior to the recurrent laryngeal nerve and the parathyroid glands. Thyroid tissue is transected. Additional hemostasis can be achieved with pressure and electrocautery, when safe to do so. The incision is then closed in the same manner as during a thyroid lobectomy.

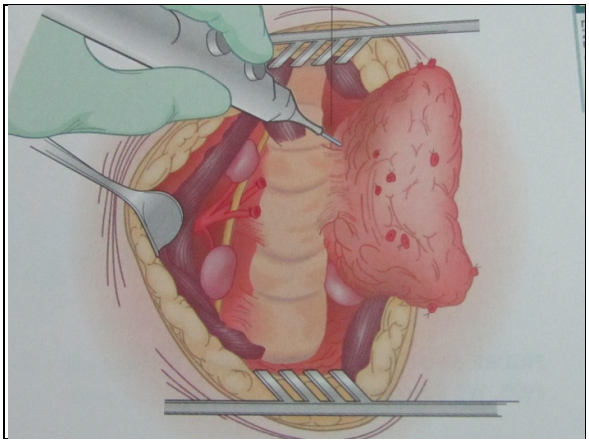
Total thyroidectomy

A total thyroidectomy is the treatment of choice for the majority of thyroid cancers. A near-total thyroidectomy leaves less than 1 g (1 cm) of

thyroid tissue on one side of the neck. It is performed when a total thyroidectomy is planned, but a minute portion of thyroid is purposely left in situ, in close proximity to the recurrent laryngeal nerve or parathyroid gland, when it is deemed unsafe to do otherwise.

A total thyroidectomy is essential performing a thyroid lobectomy on each side, without transecting the isthmus.

Separating Thyroid from Trachea



One should perform the operation on the most abnormal side of the thyroid first, so that if the nerve is inadvertently injured or invaded by thyroid cancer, a less extensive procedure can be performed on the

opposite side to ensure that the contra lateral nerve is preserved. Bilateral recurrent laryngeal nerve palsy should be avoided at all costs, as this often requires a tracheostomy to protect the patient's airway.

If a near-total or total thyroidectomy is being performed as a "completion" thyroidectomy, it should usually be performed within 5 days of the original thyroid lobectomy or at least 2 to 3 months afterward. Operating within this intervening time period is associated with reactive scar tissue and more bleeding.

Parathyroid implantation- To auto transplant a parathyroid gland, confirmation that it is normal parathyroid tissue should first be established histologically with a frozen section of a small portion of the gland, especially if the patient has thyroid cancer. While being evaluated, the remaining parathyroid tissue should be minced into pieces and placed in saline solution.

Once confirmed to be normal parathyroid, the minced parathyroid tissue is placed in a pocket created in the ipsilateral sternocleidomastoid muscle and secured with a 3-0 silk figure-eight suture that closes the muscle fascia. The site is then marked with two surgical clips. Any parathyroid gland considered to be at risk should be auto transplanted, regardless of the status of the other glands. Each parathyroid gland should be treated as if it were the only remaining functioning parathyroid tissue.

POSTOPERATIVE COMPLICATIONS OF THYROIDECTOMY

Haemorrhage(54)

A reactionary haemhorrhage from one of the thyroid arteries may lead to a tension hematoma which lies deep to cervical fascia ; sometimes the bleeding may from a thyroid vein or thyroid remnant. This is a rare but desperate emergency requiring urgent decompression by opening the layers of the wound, not simply the skin closure, to relieve tension before urgent transfer to theatre to secure the bleeding vessel. A collection of serum or subcutaneous hematoma may form under the skin flaps and require evacuation in the following 48 hours. Subcutaneous hematoma should not be confused with the tension hematomawhich is a potential life threatening situation.

Obstruction of respiration

Kinking or collapse of the trachea (tracheomalacia) may rarely causes respiratory obstruction. Most cases are caused by edema of larynx. The tension hematoma is most important cause of laryngeal oedema. Manipulation of thyroid during surgery and the anaesthetic intubation may cause laryngeal trauma, and may cause laryngeal oedema without a tension haematoma. Recurrent nerve injury either unilateral or

bilaterally will not cause respiratory obstruction in immediate post operative period. Unless laryngeal oedema is also present but it will aggravate the obstruction.

Intubation should be done immediately in a case of respiratory obstruction even when the tension hematoma is relieved.. An endotracheal should be placed for several days if necessary. Steroids may need to reduce the laryngeal edema and rarely tracheostomy may be needed. Intubation in the presence of laryngeal oedema may be very difficult and should be carried out by an experienced anaesthetist.

Repeated unsuccessful attempts may aggravate the problem and, in a crisis, it is safer to perform a needle tracheostomy as a temporary measure; a large bore 12G intravenous cannula (diameter 2.3 mm) is satisfactory.

Recurrent laryngeal nerve paralysis and voice change

RLN injury may be transient or permanent, unilateral or bilateral,. Early routine postoperative laryngoscopy reveals a much higher incidence of transient cord paralysis than is detectable by simple assessment of the integrity of the voice and cough. Such temporary dysfunction is not clinically important, however, but voice and cord function should be assessed at the first follow-up 4 weeks postoperatively.

An audit of the British Association of Endocrine Surgeons revealed an RLN palsy rate of 1.8% at 1 month declining to 0.5% at 3 months for first-time operations. Permanent paralysis of the nerve can be avoided if the nerve has been identified at operation. Injury to the external branch of the superior laryngeal nerve is more common because of its proximity to the superior thyroid artery. This leads to loss of tension in the vocal cord with diminished power and range in the voice. Patients, particularly those who use their voices professionally, must be advised that any thyroid operation will result in change to the voice even in the absence of nerve trauma. Fortunately, for most patients the changes are subtle and only demonstrable on formal voice assessment.

Thyroid insufficiency

Following subtotal thyroidectomy this usually occurs within 2 years; however, there is a small but progressive annual incidence over many years, which may be difficult to recognise and mostly insidious.. The incidence is probably higher than was previously thought and rates of 21–47% at 10 years have been reported. This results from a change in the autoimmune response physiology from stimulation to destruction of the thyroid cells. For Graves' disease there is a relationship between the development of thyroid failure after subtotal thyroidectomy and the

estimated weight of remnant of thyroid tissue. Since there is no auto immune disease in toxic adenoma ,thyroid insufficiency is rare after a surgery.

Parathyroid insufficiency

Parathyroid insufficiency occurs due to the inadverdent damage directly to the gland or causing infarction to the gland due to damage to parathyroid end artery and both can a reason. Vascular injury leading to the infarction of the gland is by far the most important reason than direct injury. The incidence of permanent hypoparathyroidism should be less than 1% and most cases present dramatically 2–5 days after operation; however, the onset of hypoparathyroidism is delayed for 2–3 weeks or a patient with marked hypocalcaemia is asymptomatic.

Thyrotoxic crisis (storm)

Acute exarcerbation of the hyperthyroid episode is termed as thyrotoxic crisis. It is now extremely rare and occurs in a hyperthyroid patient who is in toxic phase and not prepared for surgery. Thyrotoxic crisis can be precipitated in a toxic thyroid patient in a surgery unrelated to thyroid- restlesness, hyperpyrexia and dehydration should be treated symptomatic and supportive. Management may be done by

administration of intra venous fluids, usage of ice packs for cooling he patient, supply of oxygen, treating cardiac failure with the usage of diuretics, or digoxin for arrhythmias. Intra venous hydrocortisone and sedation may also prove to be useful. Specific treatment is with10-20 mg carbimazole qid, Lugol's iodine 10 drops 8-hourly orally or sodium iodide 1 g intravenously. Propranolol intravenously (1–2 mg) or orally (40 mg 6-hourly) will block β-adrenergic effects.

Wound infection

Cellulitis requiring prescription of antibiotics, often by the general practitioner, is more common than most surgeons appreciate. A significant subcutaneous or deep cervical abscess is exceptionally rare and should be drained.

Hypertrophic or keloid scar

Hypertrophic scar occurs when the incision line is not on the skin crease, overlying the sternum and black individuals. Corticosteroid injections intravenously should be given at once and repeated monthly if necessary. Scar revision rarely results in significant long-term improvement.

Stitch granuloma

Usage of non-absorbable sutures such as silk or prolene may sometimes lead to stitch granuloma. Usage of absorbable ligatures and suture materials may reduce the incidence of the stitch granuloma. Use of subcuticular absorbable skin suture rather than the traditional skin clips or staples reduced the incidence of stitch granuloma. Skin staples, if used, can be removed safely in less than 8 hours because the skin closure is supported by the platysma stitch.

Materials and Methods

Between November 2013 to September 2014, 30 patients underwent thyroidectomy (Hemi / Total) performed included in the study. All patients had routine preoperative workup for their disease and comorbidities evaluation and the same anesthetic and hospital care regardless of the surgical technique performed. A complete preoperative assessment was obtained for all patients. A 3-7 cm skin incision was made. The flaps were raised and then strap muscles were separated in the midline and laterally reflected. For total thyroidectomy the same steps were repeated for removal of the contra lateral lobe. Finally, the wound was irrigated and closed using interrupted 3-0 vicryl sutures to approximate the strap muscles and the platysmal layer. The skin was closed subcutaneously.

- The distance between the EBSLN and the superior thyroid pole was measured using a sterile silk thread which was then marked with a scale.
- This was done on either side if total thyroidectomy was performed.
- Meticulous dissection and careful dissection was made to identify the nerve.
- Based on the distance between the superior pole of the thyroid and the nerve, three types of classification was made.
- In 5 patients the nerve could not be identified.

Results

Totally 30 patients underwent thyroidectomy of which 18 patients were of multinodular goiter who underwent total thyroidectomy and remaining 12 patients were of solitary nodular thyroid(8 left and 4 right) who underwent hemithyroidectomy, total of which gives to 50 nerves for the study.

Of this, 28 nerves were of under Cernea classification IIa, 12 nerves were of classification I and 5 nerves of class IIb. Inspite of meticulous dissection and careful approach, 5 nerves could not be identified.

Table1:

Type	No	%
1	12	24
2a	28	56
2b	5	10
nil	5	10

Among 30 patients, 28 patients had type 2a ELN which accounted for about 56%. Twelve patients had type 1 ELN which accounted for about 12%. Five had type 2b ELN which constituted to about 10%. In about five patients ELN could not be identified.

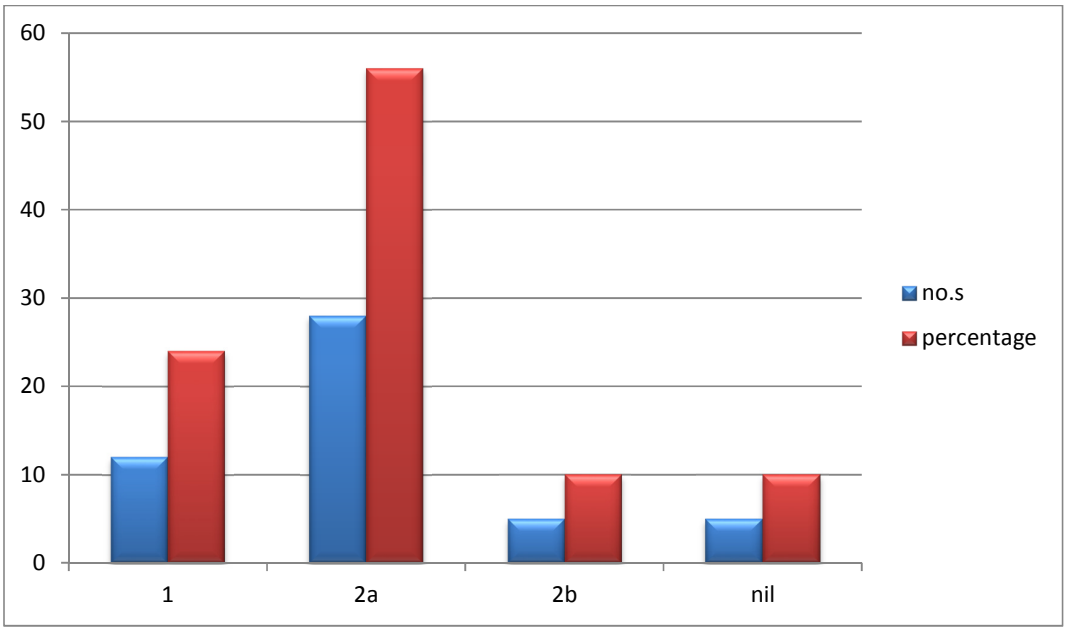


Table 2: Case distribution

Diagnosis	Surgery	No.of cases	Percentage(%)
MNG	Total thyroidectomy	18	60
SNG LT	Left Hemi thyroidectomy	8	26.6
SNG RT	Right Hemi thyroidectomy	4	13.3

In our study, eighteen patients had MNG and they undergone total thyroidectomy which constituted to about 60%. Eight patients had left SNG and they undergone Left hemithyroidectomy which accounted for about 26.6%. Four patients had right SNG and they undergone right hemithyroidectomy which accounted for about 13.3%

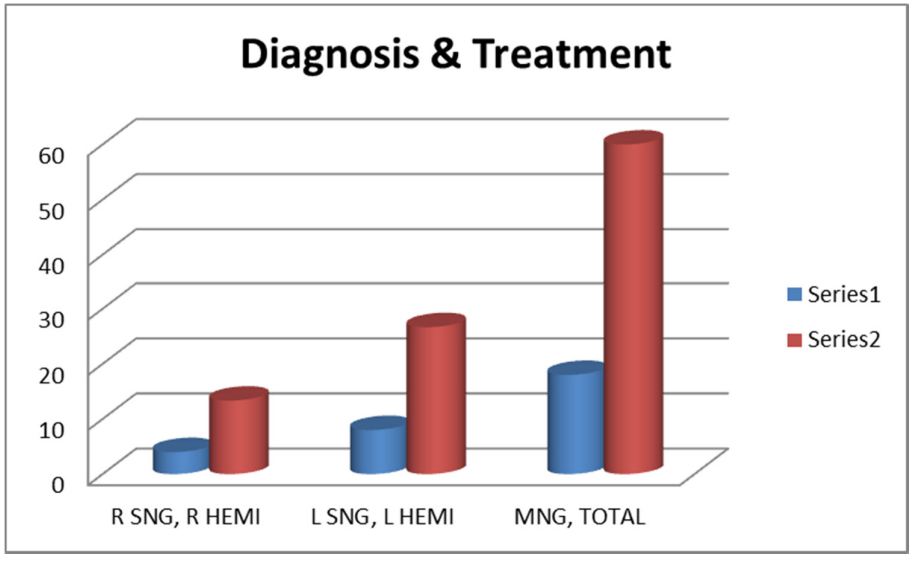


Table 3: Age distribution

Age group	percentage
Below 30	30%
31-40	27%
41-50	30%
Above 50	13%

In our study group, about 30% of patients were in the age group of 41 – 50 years and below 30 years each. About 27% of patients were in the age group of 31 – 40 years. The remaining 13% were in the age group of above 50 years.

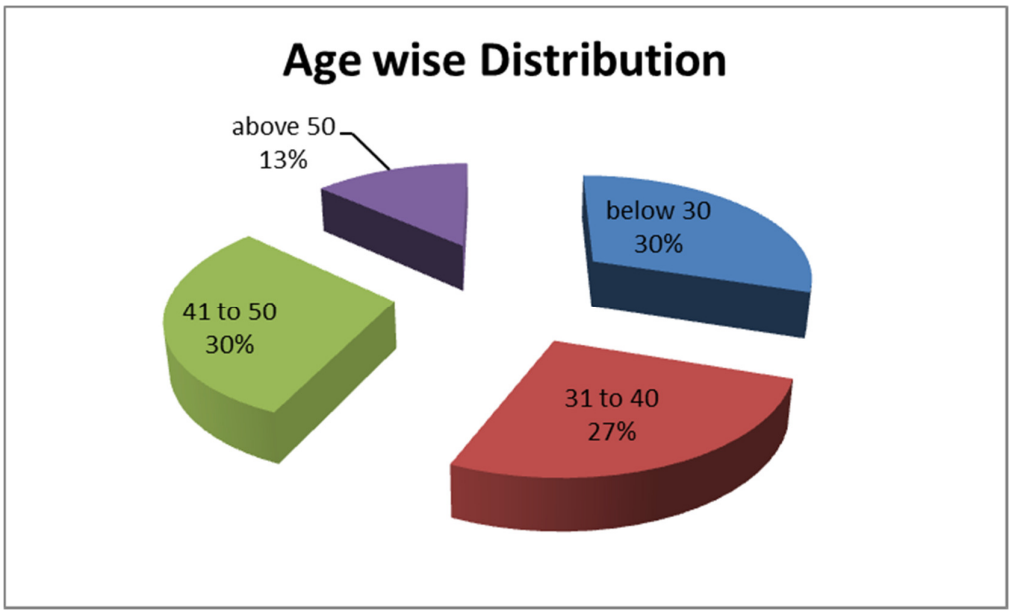
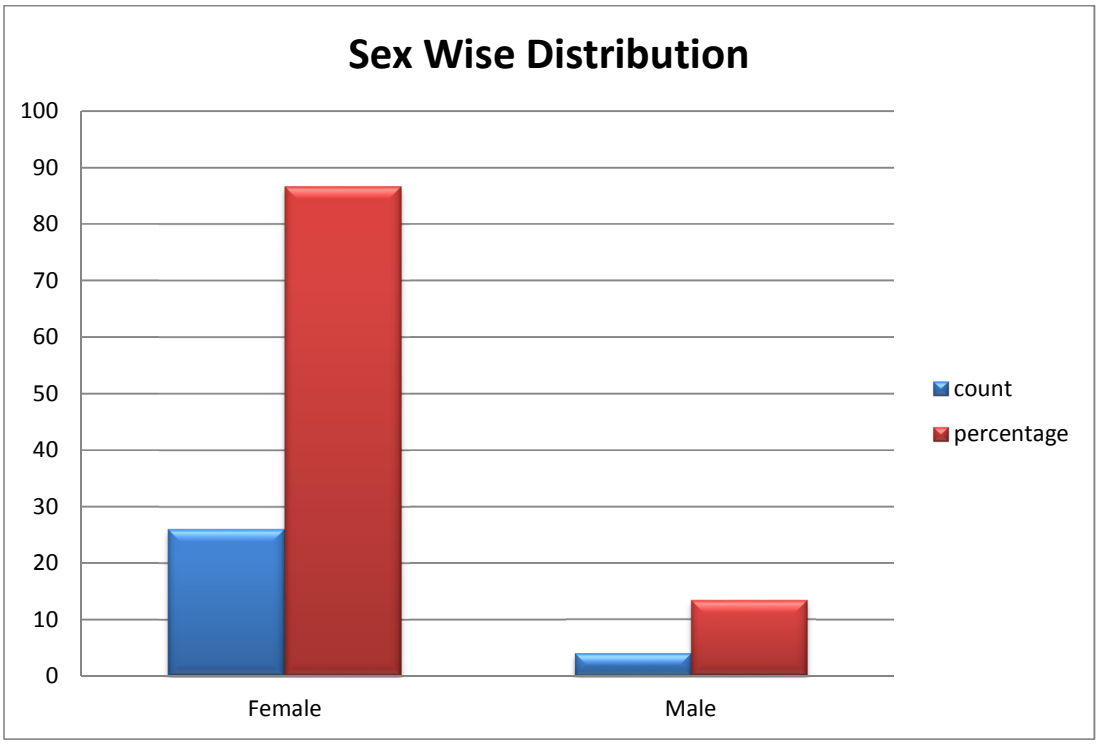


Table 4: Sex distribution

Patient Type	No.Of Patient	Percentage(%)
Female	26	87
Male	4	13

In our study population, twenty six patients were females which accounted for about 87%. The remaining four patients were males(13%).



Discussion

As per my study majority of the patients (56%) were identified to have type IIa .The second most common was type I (24%). 10% of the patients were of type IIb and remaining 10% nerves couldn't be identified.

	I	IIa	IIb	Not identified
PRESENT STUDY	24	56	10	10
A.N .AINA &A.N.HISHAM, MALAYSIA	17.3	56	26.7	7.3
PONGPEERA TAYTAWAT,THAILAND	91.8	8.2	-	-
P.V PRADDEP&B.JAYASRI,VELLORE	70.7	17.9	8	3.4
MICHAEL FRIED MAN, CHICAGO	68	11	14	-

The result of the present study is similar to the study attempted by A.N Aina and Hashim in Malaysia were type IIa was common. The other studies have different results with either type I as most common variety.the variations seen may be related to the fact of geographical location ,gender or size of the gland.

Also out of 30 patients only four were male patients and within them 75% of them presented with multi nodular goiter and 25% presented with solitary nodule of thyroid. Of the total 18 multi nodular goiter patients who have undergone total thyroidectomy 33.3% patients had same type of nerve on both side of which the most common type is IIa.50% of the patient had nerve located at different levels and also within this variation type IIa was the most common.

	a.n .aina &a.n.hisham, malaysia		**Present Study**	
	r	**l**	**r**	**l**
Type I	70.7	72.3	16.6	30.7
Type IIa	17.9	15.7	50	61.5
Type IIB	8	6.5	20.8	-
Not identified	3.3	5.4	12.5	7.6

Conclusion

- In the present study type IIa is the most common variant
- As of exploration and identification of **RLN** became mandatory ,in the near future identification of external laryngeal nerve may become mandatory.
- Exposure and preservation of the nerve would be aided by the recognition of the potential avascular space of reeve.in order to reduce the morbidity related to the thyroid surgery
- Fine meticulous dissection to explore and identify the external laryngeal nerve prevents cent percent preservation from the iatrogenic injury.
- Variants of the nerve type doesn't affect the post operative outcome but meticulous dissection in identification of the nerve prevents its injury.

KEY TO MASTER CHART

IPNO	In Patient Number
DOA	Date Of Admission
DOD	Date Of Discharge
MNG	Multi Nodular Goiter
SNG	Solitary Nodular Goiter
Rt Hemi	Right Hemithyroidectomy
Lt Hemi	Left Hemithyroidectomy
HPE	Histo Pathological Examination
AG	Adenomatous Goiter
FA	Follicular Adenoma
NG	Nodular Goiter
CG	Colloid Goiter
NCG	Nodular Colloid Goiter

s.no	name	age	sex	IP NO	DIAGNOSIS	SURGERY	R EBSLN	L EBSLN
1	Suja	45	f	52710	L SNG	L HEMI		1
2	Kannamal	55	f	52207	L SNG	L HEMI		1
3	Chinnathai	52	f	52200	MNG	TOTAL	2a	2a
4	Nathia	25	f	51516	MNG	TOTAL	1	2a
5	Meenakshi	30	f	50730	MNG	TOTAL	1	2a
6	Meena	27	f	48668	MNG	TOTAL	2a	1
7	Laksmi	50	f	47857	R SNG	R HEMI	0	
8	Shanmugavalli	52	f	43882	R SNG	R HEMI	2a	
9	Angayarkanni	30	f	41227	MNG	TOTAL	2a	2a
10	Anitha banu	34	f	41195	MNG	TOTAL	2a	2a
11	Amaravathy	46	f	41082	L SNG	L HEMI		2a
12	Saraswathy	24	f	39745	MNG	TOTAL	2a	2a
13	Sakila banu	38	f	39706	L SNG	TOTAL	2b	1
14	Parvathy	36	f	33535	MNG	TOTAL	1	2a
15	Meenakshi	38	f	30518	L SNG	TOTAL	0	2a
16	Lalitha	30	f	29993	MNG	TOTAL	2b	2a
17	Poochiammal	50	f	27172	MNG	TOTAL	2a	1
18	Panchavarnam	27	f	24926	MNG	TOTAL	2a	2a
19	Suruliammal	70	f	18177	MNG	TOTAL	2a	2a
20	Ammani	43	f	13616	MNG	TOTAL	1	2a
21	Maragathivalli	40	f	10806	MNG	TOTAL	2b	0
22	Seethalakshmi	42	f	80608	L SNG	L HEMI		2a
23	Palaniammal	38	f	7159	L SNG	L HEMI		1
24	Kaleeswari	23	f	5286	R SNG	R HEMI	2b	
25	Eswari	31	f	9514	R SNG	R HEMI	2a	
26	Vijayalakshmi	36	f	81448	MNG	TOTAL	2b	2a
27	Mariappan	42	m	49779	MNG	TOTAL	0	1
28	Karuppiah	47	m	52946	MNG	TOTAL	2a	2a
29	Veeranan	45	m	40086	MNG	TOTAL	2a	1
30	Kirubakaran	19	m	50507	L SNG	L HEMI		0

Bibliography

1. Droulias C, Tzinas S, Harlaftis N, Akin JT Jr, Gray SW, Skandalakis JE. The superior laryngeal nerve. Am. Surg. 1976; 42: 635–8.

2. Kark AE, Kissin MW, Auerbach R, Meikle M. Voice changes after thyroidectomy: Role of the external laryngeal nerve. BMJ 1984; 289: 1412–15.

3. Jansson S, Tisell LE, Hagne I, Sanner E, Stenborg R, Svensson P. Partial superior laryngeal nerve (SLN) lesions before and after thyroid surgery. World J. Surg. 1988; 12: 522–7.

4. Moosman DA, Deweese SM. The external laryngeal nerve as related to thyroidectomy. Surg. Gynecol. Obstet. 1968; 127: 1011–16.

5. Thompson NW, Olsen RW, Hoffman LG. The continuing development of the technique of thyroidectomy. Surgery 1973; 73: 913–17.

6. Hisham A, Bliss R, Reeve T, Delbridge L. Recognition of the avascular space medial to the upper pole of the thyroid and its surgical implications. Asian J. Surg. 2000; 23: 86–9.

7.Pearse A.G., Carvalheira A.F. Cytochemical evidence for an ultimobranchial origin of rodent thyroid C

cells. Nature. 1967;214(5091):929–930.

8. Burke J.S., et al. Monoclonal small (well-differentiated) lymphocytic proliferations of the

gastrointestinal tract resembling lymphoid hyperplasia: a neoplasm of uncertain malignant potential. Hum

Pathol. 1987;18(12):1238–1245

9.Gauger P.G., et al. Incidence and importance of the tubercle of Zuckerkandl in thyroid surgery. Eur J

Surg. 2001;167(4):249–254.

10. Pelizzo M.R., Toniato A., Gemo G. Zuckerkandl's tuberculum: an arrow pointing to the recurrent

laryngeal nerve (constant anatomical landmark). J Am Coll Surg. 1998;187(3):333–336

11.lennquist S cahlin C,smeds S,.he superior laryngeal nerve in thyroid surgery.1987;102;999

12.cernea CR,ferraz AR,surgical anatomy of superior laryngeal nerve,WB saunders,2003.

13.Dionigi G., Chiang F.Y., Rausei S., et al. Surgical anatomy and neurophysiology of the vagus nerve

(VN) for standardised intraoperative neuromonitoring (IONM) of the inferior laryngeal nerve (ILN) during

thyroidectomy. Langenbecks Arch Surg. 2010;395(7):893–899.

14. Hunt P.S., Poole M., Reeve T.S. A reappraisal of the surgical anatomy of the thyroid and parathyroid

glands. Br J Surg. 1968;55(1):63–66.

15. Shindo M.L., Wu J.C., Park E.E. Surgical anatomy of the recurrent laryngeal nerve revisited.

Otolaryngol Head Neck Surg. 2005;133(4):514–519.

16.Hisham A.N., Lukman M.R. Recurrent laryngeal nerve in thyroid surgery: a critical appraisal. ANZ J

Surg. 2002;72(12):887–889.

17.Boyd J.D. Development of thyroid and parathyroid glands and the thymus. Ann R Coll Surg Engl.

1950;7:455–471.

18.Henry J.F., et al. The nonrecurrent inferior laryngeal nerve: review of 33 cases, including two on the

left side. Surgery. 1988;104(6):977–984.

19.Coady M.A., et al. Nonrecurrent laryngeal nerve during carotid artery surgery: case report and literature

review. J Vasc Surg. 2000;32(1):192–196.

20. Crile G. Diagnosis and Treatment of Diseases of the Thyroid Gland. Philadelphia: W.B. Saunders;

1932.

22. Sackett W.R., et al. Thyrothymic thyroid rests: incidence and relationship to the thyroid gland. J Am

Coll Surg. 2002;195(5):635–640.

23 Snook K.L., et al. Recurrence after total thyroidectomy for benign multinodular goiter. World J Surg.

2007;31(3):593–598. discussion 599–600

24. Cernea C.R., et al. Surgical anatomy of the external branch of the superior laryngeal nerve. Head Neck.

1992;14(5):380–383.

25. Lennquist S., Cahlin C., Smeds S. The superior laryngeal nerve in thyroid surgery. Surgery.

1987;102(6):999–1008.

26.Sow M.L., et al. Le nerf laryngé externe dans le chirurgie d' exérèse thyroidienne: correlations

anatomo-chirurgicales à propos de 30 dissections. Dakar Med. 1982;27:177.

27.Lang J., et al. Über den Nervus Laryngeus superior und die Arteria Laryngea superior. Acta Anat.

1987;130:309

28. Craton J. Amelita Galli-Curci. www.chez.com/craton/musique/

galli-curci/english.htm

29. G ulec SA, O'Leary JP. Fable on the superior laryngeal

nerve. Am Surg 1999;65:490-2.

30. L e Massena CE. Galli-Curci's life of song: a biography.

Palm Springs, CA: Monitor Book Co; 1977

31. Lennquist S., Cahlin C., Smeds S. The superior laryngeal nerve in thyroid surgery. Surgery.

1987;102:999.

32.Kierner A.C., Aigner M., Burian M. The external branch of the superior laryngeal nerve: its

topographical anatomy as related to surgery of the neck. Arch Otolaryngol Head Neck Surg. 1998;124:301.

33. Friedman M., LoSavio P., Ibrahim H. Superior laryngeal nerve identification and preservation in

thyroidectomy. Arch Otolaryngol Head Neck Surg. 2002;128:296–303.

34. Arnold G.E. Physiology and pathology of the cricothyroid muscle. Laryngoscope. 1961;71:687.

35. Hong K.H., et al. Functional differences between the two bellies of the cricothyroid muscle.

Otolaryngol Head Neck Surg. 1998;118:714.

36.Arnold G.E. Physiology and pathology of the cricothyroid muscle. Laryngoscope. 1961;71:687.

37. Cernea C.R., et al. Identification of the external branch of the superior laryngeal nerve during

thyroidectomy. Am J Surg. 1992;164:634.

38. Furlan J.C., Cordeiro A.C., Brandão L.G. Study of some “intrinsic risk factors” that can enhance an

iatrogenic injury of the external branch of the superior laryngeal nerve. Otolaryngol Head Neck Surg.

2003;128:396–400.

39. Rossi R.L., Cady B., Silverman M.L. Current results of conservative surgery for differentiated thyroid

carcinoma. World J Surg. 1986;10:612.

40. Jansson S., et al. Partial laryngeal nerve lesions before and after thyroid surgery. World J Surg.

1988;12:522.

41. Hong K.H., et al. Functional differences between the two bellies of the cricothyroid muscle.

Otolaryngol Head Neck Surg. 1998;118:714

42. Berlin D., Lahey F.H. The relationship of the recurrent laryngeal nerve to the inferior thyroid artery

and the relationship of the superior to abduction paralysis. Surg Gynecol Obstet. 1929;49:102.

43. Robinson J.L., Mandel S., Sataloff R.T. Objective voice measures in nonsinging patients with

unilateral superior laryngeal nerve paresis. J Voice. 2005;19(4):665–667.

44. Cernea C.R., Ferraz A.R., Furlani J., et al. Identification of the external branch of the superior

laryngeal nerve during thyroidectomy. Am J Surg. 1992;164(6):634–639.

45. Eisele D.W., Goldstone A.C. Electrophysiologic identification and preservation of the superior

laryngeal nerve during thyroid surgery. Laryngoscope. 1991;101(3):313–315.

46. . J.Larry Jameson,Anthony P.Weetman.Diseases of the Thyroid gland.Dennis L.Kasper. Harrison's Principles of Internal Medicine ,16th edition.United States of America,Chapter ,The Mcgraw Hill Companies,Inc.;2005;2108-9.

47. WebMD.com [Internet].Available from:http:/www.webmd.com/ a-to-z-guides/thyroid and parathyroid ultrasound

48. A.J. Jones, T.J. Aitman, C.J. Edmonds, M. Burke, E. Hudson ,M. Tellez. Comparison of fine needle aspiration cytology, radioisotopic and ultrasound scanning in the management of thyroid nodules. Postgrad Med J 1990; 66:914 -7

49. D. N. Poller, E. B. Stelow, C. Yiangou. Thyroid FNAC cytology: can we do it better. Cytopathology 2008;19:4-10

50. MA Tabaqchali, JM Hanson, SJ Johnsont, V Wadehrat, TWJ Lennard, G Proud. Thyroid aspiration cytology in Newcastle: a six year cytology/histology correlation study. Ann R Coll Surg Engl 2000; 82: 149-55

51. Nicholas J. Screaton, Laurence H. Berman, John W. Grant. US-guided Core-Needle Biopsy of the Thyroid Gland. Radiology 2003;226:827-32.0

52. J.A. Patton, M.P. Sandler, C.L. Partain. Prediction of Benignancy of the Solitary "Cold" Thyroid Nodule by Fluorescent Scanning. J Nucl Med 1985;26:461-464.

53. . Krukowski ZH. The thyroid gland and thyroglossal tract. Chapter 53 In: Russel RCG, Williams NS, Bulstrode CJK, edts. Bailey and Love's Short Practice of Surgery. 24th ed. London: Arnold Publication; 2004.p.787

54. Zygmunt H.Krukowski, Thyroid Bailey & Love 25th Edition, RCG.Russell norman S. Williams & Chirstopher P.796-797

ANNEXURE-1

Name	IP No:
Age	Date of Admission:
Sex	Date of Surgery:
Occupation	Date of Discharge:
Address	

Chief complaints:

Duration:

Swelling in the Right / Left side of thyroid:

HISTORY OF PRESENT COMPLAINTS:

Duration/ Progression

Local Effects

Pressure symptoms- dyspnoea / dysphagia / dysphonia

Symptoms of hyperthyroidism / hypothyroidism

Symptoms suggestive of malignancy

Other symptoms

PAST HISTORY:

History of previous thyroid disorder

History of goitrogen intake.

Drug history /Radiation exposure

Treatment history

MENSTRUAL HISTORY:

Family History:

History of Thyroid disease

History of Diabetes, Hypertension , malignancies

PERSONAL HISTORY:

Diet Appetite

Sleep Bowel/Bladder

Habits

GENERAL PHYSICAL EXAMINATION:

Appearance, build, nutritional assessment

Pallor: Clubbing

Icterus Edema

Cyanosis Lymphadenopathy

Vitals: BP/ Respiratory Rate

PULSE

1. Rate
2. Rhythm
3. Character
4. Volume

LOCAL EXAMINATION

1.INSPECTION

a. Site b. Size

c. Shape d. Surface

e. Extent f. Margins

g. Skin over the swelling h. Distended veins/pulsations

i. Movement with deglutition j. Position of trachea

2. Palpation

a. Local temperature b. Tenderness

c. Site, size, shape and extent d. Surface

e. Borders f. Consistency

g. Mobility h. Fixity to skin

i. Plane of swelling j. Examination of lymph nodes

k. Tracheal position

l. Carotid pulsation

2. Percussion

3. Auscultation

SYSTEMIC EXAMINATION

1. CVS 2. RS

3. CNS 4. Per Abdomen

5. Skull and spine.

INVESTIGATIONS

ROUTINE INVESTIGATIONS:

a. Blood Routine: b. Serology: HIV / HBsAg / VDRL

c.ECG d. Chest X-Ray PA view

e. X ray of neck AP and lateral view

f. Indirect Laryngoscopy

SPECIFIC INVESTIGATIONS:

a. Thyroid profile- TSH, T3, T4

b. USG neck c. FNAC d. Others

FINAL DIAGNOSIS:

Treatment

Preoperative Management:

OPERATIVE TREATMENT :

Date : Procedure :

Post-op. diagnosis : Anaesthesia :

Findings :

OPERATIVE DETAILS :

Total lobectomy

Lobectomy / Hemithyroidectomy

Subtotal thyroidectomy

Near total thyroidectomy

Total thyroidectomy

Total thyroidectomy with parathyroid autotransplantation

Visualization of external Laryngeal nerve:

a. Vocal cords visualization at extubation :